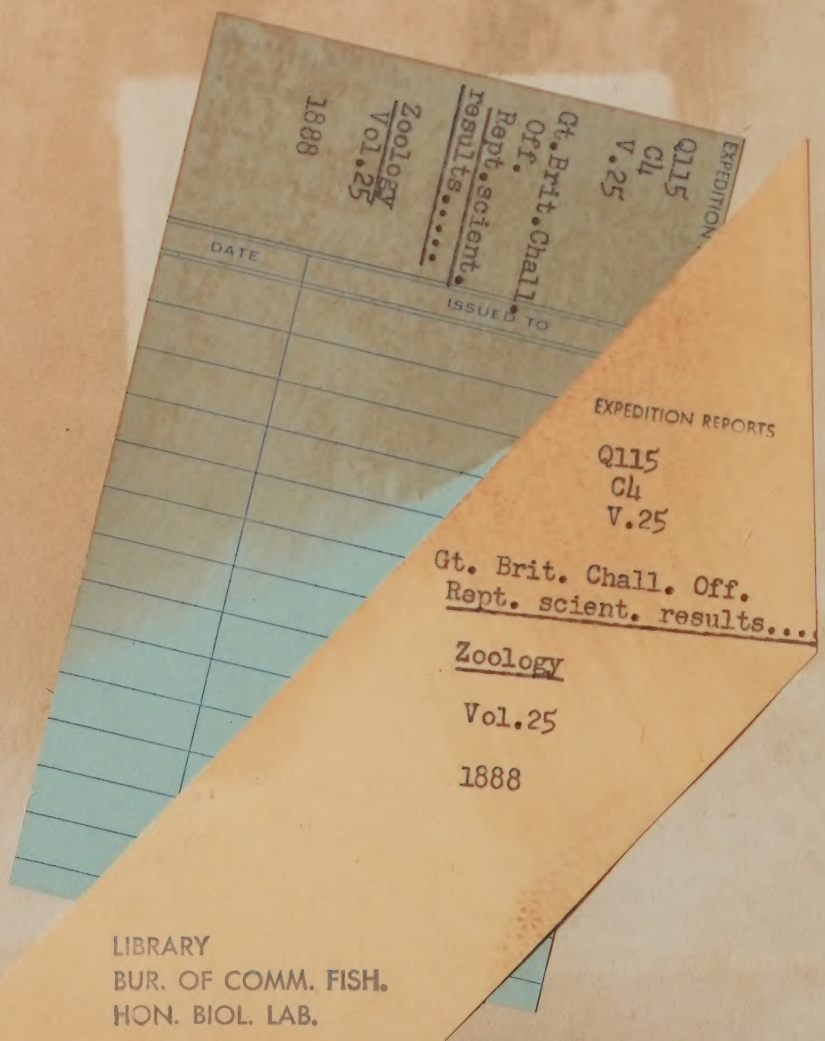
AUG 1956
LIBRARY
POFI
FISH & WILDLIFE
SERVICE



LIBRARY
BUR. OF COMM. FISH.
HON. BIOL. LAB.

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY—VOL. XXV.

UNITED STATES COMMISSION
3416
FISH & FISHERIES.

LIBRARY
& WILDLIFE SERVICE
IC OCEANIC FISHERY
INVESTIGATIONS

REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

UNDER THE COMMAND OF

CAPTAIN GEORGE S. NARES, R.N., F.R.S.

AND THE LATE

CAPTAIN FRANK TOURLE THOMSON, R.N.

PREPARED UNDER THE SUPERINTENDENCE OF

THE LATE

Sir C. WYVILLE THOMSON, Knt., F.R.S., &c.

REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF EDINBURGH

DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF ON BOARD

AND NOW OF

JOHN MURRAY

ONE OF THE NATURALISTS OF THE EXPEDITION

BUREAU OF FISHE
LIBRARY
WOODS HOL

ZOOLOGY—VOL. XXV.

3916

Published by Order of Her Majesty's Government

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE

AND SOLD BY

LONDON:—EYRE & SPOTTISWOODE, EAST HARDING STREET, FETTER LANE

EDINBURGH:—ADAM & CHARLES BLACK

DUBLIN:—HODGES, FIGGIS, & CO.

1888

Price Forty-two Shillings

UNITED STATES COMMISSION
3916

73 L0

LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

PRINTED BY NEILL AND COMPANY, EDINBURGH,
FOR HER MAJESTY'S STATIONERY OFFICE.

CONTENTS.

Report on the Tetractinellida collected by H.M.S. Challenger, during the years 1873–1876.

By W. J. Sollas, M.A., D.Sc., LL.D., Dublin, Professor of Geology and Mineralogy in the University of Dublin; late Fellow of St. John's College, Cambridge.

EDITORIAL NOTE.

This Volume contains a comprehensive Report on the Tetractinellid Sponges collected during the Expedition, by Professor W. J. Sollas, LL.D., of the University of Dublin. It forms Part LXIII. of the Zoological Series of Reports, and extends to 622 pages of letterpress, illustrated by 44 chromo-lithographic plates, a map, and a large number of woodcuts. Professor Sollas has added a notice of species not met with in the Challenger collection; this Report forms therefore a complete monograph of the group.

The Manuscript was received by me in Instalments between the 31st August 1886 and the 24th February 1888.

This Report concludes the account of the Sponges collected by the Expedition. The other Reports dealing with this large group have been published as follows :—

Part XXIV. (Volume VIII.), Report on the Calcarea, by N. Poléjaeff, published in 1883.

Part XXXI. (Volume XI.), Report on the Keratosa, by N. Poléjaeff, published in 1884.

Part LIX. (Volume XX.), Report on the Monaxonida, by S. O. Ridley and A. Dendy, published in 1887.

Part LIII. (Volume XXI.), Report on the Hexactinellida, by F. E. Schulze, published in 1887.

John Murray.

Challenger Office, 32 Queen Street,
Edinburgh, 12*th May* 1888.

ERRATA.

Page xxviii, fifth line from the top, for "*Eusiphonia*" read "*Neosiphonia*."

Page xxx, fourth line from the bottom, for "*Aparctidella schulzii*" read "*Tethyopsis radiata*."

Page lxxiv, in table of phylogeny, *after* "dichotriæne" *insert* "of the family Thrombidæ." The dichotriæne of the Astrophora is undoubtedly derived from the pro-, plagio-, or orthotriæne within the suborder.

Page xcii, sixteenth line from bottom, *insert* "Vosmaer" *before* "Heider."

Page 38, eighth line from bottom, *Craniella schmidtii*, in the measurement of the chord of the anatriæne, *read* "0·1 mm." *for* "0·01 mm."

Page 54, bottom line, *Craniella tethyoides*, in the measurement of the chord of the anatriæne, *read* "0·11 mm." *for* "0·011 mm."

Page 55, fifteenth line, *Craniella zetlandica*, the length of the chord should *read* "0·13 mm." *instead of* "0·013 mm."

Page 88, second line, read "*Caltheropella simplex*, page 107," for "*Caltheropella geodides*, page 110."

Page 140, eighth line, *read* "orthotriæne" *for* "protriæne."

Page 147, thirteenth line, *Anthastra pyriformis*, in the measurements of the cladome of the anatriæne, *read* "sagitta 0·048 mm., chord 0·1114 mm."

Page 206, *Stellettinopsis annulata*, here doubtfully referred to *Asteropus*, is probably a *Sphinctrella*.

Page 277, fourteenth line, *for* "so many" *read* "some."

Pages 278–280, where the words "hypomere and spongomere" occur, *read* "hypophare and spongophare."

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the TETRACTINELLIDA collected by H.M.S. Challenger during the Years 1873–76. By W. J. SOLLAS, M.A., D.Sc. Cambridge, LL.D. Dublin, Professor of Geology and Mineralogy in the University of Dublin; late Fellow of St. John's College, Cambridge.

PREFACE.

THE Tetractinellid Sponges brought home by the Challenger Expedition were sent to me for description by Mr. John Murray on the 15th of July 1882. Numerous unforeseen interruptions, one of the chief being a removal from Bristol to Dublin, will account for the delay which has occurred in the completion of the Report.

It was not to be expected that a complete separation of the Tetractinellid from the Monaxonid sponges should be accomplished at one operation, and I have continued to receive from time to time additional specimens from my colleagues, Messrs. Ridley and Dendy, the last reaching me so late as the close of last year (1886). In this connection the uncertainty attaching to the systematic position of the Tethyidæ has proved a source of great perplexity, and the specimens of this group have changed hands more than once. Messrs. Ridley and Dendy could find no place for them among the Monaxonida, and I was unwilling at first to disturb the symmetry of the Tetractinellida by including in it sponges which do not possess Tetractinellid spicules; when, however, this appeared to be inevitable in the case of *Placospongia*, a genus which is united to the Geodiidæ by the presence of sterrasters, but which is certainly without any Tetractinellid spicules, this objection could not be pressed, and I undertook to describe the Tethyidæ under the impression that they bore much the same relation to the Stellettidæ that *Placospongia*

does to the Geodiidæ. Subsequent examination has convinced me, however, that the analogy here suggested is misleading, and that the Tethyidæ are in all probability Monaxonid sponges. As this conclusion was not reached till my description of the family was completed, an account of it is given in an Appendix to this Report.

The Tetractinellid sponges of the Challenger collection are in an excellent state of preservation, all but some ten or twelve being preserved in strong alcohol; so that I have been enabled to make a thorough investigation of the minute as well as the coarse anatomy of almost every species. This has been a work involving some labour: several thousands of thin slices have been cut, and hundreds of other preparations made according to methods which will be found described in the chapter on Technique.

As no complete system of the Tetractinellida has yet been published, I gladly availed myself of Mr. Murray's kind permission to enlarge the scope of this Report by including an account of all other species of Tetractinellida known to me, besides those contained in the Challenger collection. These additional species are treated separately in appendixes to each family.

The number of species and varieties of Tetractinellida obtained by the Challenger is 87, of which 73 are new to science; they are arranged in 38 genera, of which 18 are new; of additional species described in this Report there are 221, and of additional genera 45, of which 15 are new.

The total number, therefore, of described species of Tetractinellida, inclusive of the doubtful family Epipolasidæ, is 294, and of accepted genera 81.

My best thanks are due and heartily tendered to those distinguished zoologists who have helped to render a system of the Tetractinellida possible by furnishing me with the requisite material. To Professor Agassiz I am especially indebted since he sent me across the Atlantic the whole, or nearly the whole, of the "Hassler" collection of Lithistids, including many unique specimens, the originals of O. Schmidt's descriptions, and no less to Professor von Graff, who, with a generosity which I can only refer to as lavish, furnished me with an almost complete series of examples from O. Schmidt's types of Adriatic sponges. I am also deeply indebted to Professor Perrier of Paris and Dr. Ernest Ziegler of Strasburg for many examples of other sponges described by O. Schmidt, and to Professor Stewart who gave me every assistance in the examination of specimens described by Bowerbank and now preserved in the Royal College of Surgeons. Especial thanks are due to Mr. S. O. Ridley, who has constantly helped me to specimens, and who placed at my disposal for examination all the specimens in the fine collection of Tetractinellid sponges preserved in the British Museum, where are to be found most of Bowerbank's species, and specimens of many of Carter's and O. Schmidt's, together with a host of miscellaneous examples, all well arranged and readily accessible,—thanks to Mr. Ridley's labours in this department. To my friend and colleague Professor E. Perceval Wright, who presented me with parts of several important type specimens,

including mountings of Selenka's interesting species *Stelletta nux* and *Stelletta bacca*, the systematic position of which has hitherto remained a matter for conjecture, and to my friend Professor Haddon, who has generously helped me with specimens and advice, I am also under great obligations. Professor Haddon has further done me the invaluable service of looking over the proof sheets of the chapters on Morphology. With my friend Mr. H. J. Carter I have been in constant communication, and, thanks to the information and the numerous specimens I owe to his kindness, I have been able to clear up several points that would otherwise have remained doubtful and perplexing. Finally I have to express my thanks to Professor Flower and Dr. Günther for permitting me to consult the collections in the British Museum. The plates and illustrations were drawn by my friend the well-known artist Mr. T. H. Thomas, R.C.A., who, at considerable personal inconvenience and to the neglect of more artistic work, came from Cardiff to reside at Dublin for the purpose. The figures representing structure were traced by me with the camera lucida, and were then drawn by Mr. Thomas direct from the object under the microscope; the tracings being used simply to insure accuracy in scale and outline. These drawings are therefore faithful illustrations of what is actually to be seen in the preparations they represent, including their imperfections. Perhaps they err a little too far on the side of faithfulness, but this I hold is better than introducing corrections and interpretations into a picture till it loses its likeness to the original, and becomes a subjective rather than an objective representation of the truth as it is in nature. In this Report the expression of inferences and deductions has been left to woodcuts and the letterpress.

CONTENTS.

PAGE

I. INTRODUCTION, ... xi–xii

II. MORPHOLOGY—

1. General Structure.—The Rhagon; Types of Chamber-System, Eurypylous, Aphodal, and Diplodal; Ectosome and Choanosome; Subdermal and Subcortical Cavities. Types of Canal System; the Oscule and Pores; Secondary Canals or Epochetose System, . xiii–xxxv
2. Histology.—Collenchyme and Collencytes, Sarcenchyme and Sarcencytes, Cystenchyme, Chondrenchyme, Thesocytes, Chromatocytes, Inocytes, Myocytes, Æsthocytes, Protoplasmic Continuity, Scleroblasts, Genital Products, ... xxxv–xlvii
3. The Skeleton.—Skeletal Elements, Opal, and Spongin; Spicules, Structure, Classification, Ontogeny, Phylogeny, Ætiology of Spicules; Types of Arrangement; Extrusion of Spicules; Source of the Silica of Flints, ... xlvii–xci
4. Ontogeny, ... xci
5. Classification.—Position of the Sponges in the Animal Kingdom, Subdivision into Classes; Classification of the Tetractinellida; Description of Families and Genera, . xcii–clix
6. Note on Phylogeny, ... clx, clxi
7. Methods of Investigation, ... clxi–clxvi

III. DESCRIPTION OF SPECIES—

Order I. Choristida, ... 1
Suborder I. Sigmatophora, ... 1
Family I. Tetillidæ, ... 1
Tetilla, O. Schmidt, ... 1–17
Chrotella, Sollas, ... 17–23
Cinachyra, Sollas, ... 23–30
Craniella, O. Schmidt, ... 30–41
Supplementary Account of Tetillidæ not in the Challenger Collection, . 42–57
Tetilla, ... 42–50
Craniella, ... 50–55
Fangophilina, O. Schmidt, ... 55
Tabular View of the Tetillidæ, ... 56–57
Family II. Samidæ, ... 57
Samus, Gray, ... 57–59
Suborder II. Astrophora, ... 59
Demus I. Streptastrosa, ... 59
Family I. Theneidæ, ... 59
Thenea (Gray), ... 59–78
Pœcillastra, Sollas, ... 79–86
Sphinctrella, O. Schmidt, ... 87–91
Characella, Sollas, ... 91–93
Triptolemus, n. gen., ... 93–94

PAGE

Supplementary Account of Theneidæ not in the Challenger Collection, . 95–104
Thenea, ... 95–98
Pœcillastra, ... 98–100
Sphinctrella, ... 100
Characella, ... 101
Triptolemus, ... 102
Stœba, n. gen., ... 102
Nethea, n. gen., ... 103
Placinastrella, F. E. Schultze, ... 103–104
Family II. Pachastrellidæ, ... 104
Pachastrella, O. Schmidt, ... 104–107
Calthropella, n. gen., ... 107–108
Supplementary Account of Pachastrellidæ, not in the Challenger Collection, ... 108–112
Dercitus, Gray, ... 108–109
Pachastrella, ... 110
Calthropella, ... 111
Genus? 111–112
Demus II. Euastrosa, ... 112
Family I. Stellettidæ, ... 112
Subfamily 1. Homasterina, ... 112
Myriastra, Sollas, ... 112–120
Pilochrota, Sollas, ... 120–135
Astrella, Sollas, ... 136–138
Subfamily 2. Euasterina, ... 138
Anthastra, Sollas, ... 138–149
Stelletta (O. Schmidt), ... 150–153
Subfamily 3. Sanidasterina, ... 153
Tribrachium (Weltner), ... 153–161
Disyringa, n. gen., ... 161–171
Stryphnus, Sollas, ... 171–174
Subfamily 4. Rhabdasterina, ... 174
Psammastra, Sollas, ... 174–177
Appendix to the Euastrosa, ... 177–178
Family Epipolasidæ, ... 177
Amphius, n. gen., ... 177–178
Supplementary Account of Stellettidæ not in the Challenger Collection, . 179–205
Myriastra, ... 179
Pilochrota, ... 180–181
Astrella, ... 181–183
Anthastra, ... 183–184
Stelletta, ... 184–187
Dragmastra, Sollas, ... 187
Aurora, n. gen., ... 187–188
Ancorina (O. Schmidt), ... 188–189
Tethyopsis, Stewart, ... 189–191
Ecionema (Bowerbank), ... 195–198
Papyrula, O. Schmidt, ... 198–199
Algol, n. gen., ... 200–201

PAGE

Supplementary Account of Epipolasidæ not in the Challenger Collection, . 205–209
Asteropus, n. gen., ... 205–206
Coppatias, n. gen., ... 206–209
Demus III. Sterrastrosa, ... 209
Family I. Geodiidæ, ... 209
Subfamily Erylina, ... 209
Erylus, Gray, ... 209–214
Caminus, O. Schmidt, ... 214–218
Subfamily Geodina, ... 218
Cydonium (Müller), ... 218–227
Synops, Vosmaer, ... 227–235
Isops, Sollas, ... 236–237
Supplementary Account of Sterrastrosa not in the Challenger Collection, . . 237–274
Family I. Geodiidæ, ... 237
Erylus, Gray, ... 237–241
Caminus, O. Schmidt, ... 241–242
Pachymatisma (Bowerbank), ... 242–244
Geodia (Lamarck), ... 244–254
Cydonium, ... 255–265
Synops, ... 265–267
Isops, ... 267–271
Family II. Placospongidæ, ... 271
Placospongia, Gray, ... 271–273
Incertæ sedis—Antares, n. gen., ... 274
Suborder III. Microsclerophora, ... 274
Family III. Thrombidæ, ... 274
Thrombus, Sollas, ... 275–278
Supplementary Account of Microsclerophora not in the Challenger Collection, ... 278–283
Family I. Placinida, F. E. Schulze, ... 278
Placina, F. E. Schulze, ... 278–279
Placortis, F. E. Schulze, ... 279
Family II. Corticidæ, Vosmaer, ... 279
Corticium, O. Schmidt, ... 280
Calcabrina, n. gen., ... 280
Corticella, n. gen., ... 281
Rhachella, n. gen., ... 281
Family III. Thrombidæ, ... 282
Thrombus, ... 282–283
Order II. Lithistida, ... 284
Suborder Hoplophora, ... 284
Demus I. Triænosa, ... 284
Family I. Tetracladidæ, Zittel, ... 284
Theonella (Gray), ... 284–292
Discodermia (Bocage), ... 292–299
Neosiphonia, n. gen., ... 299–301
Family II. Corallistidæ, ... 301
Corallistes (O. Schmidt), ... 301–309
Callipelta, n. gen., ... 309–312

PAGE

Family III. Pleromidæ, ... 312
Pleroma, n. gen., ... 312–315
Demus II. Rhabdosa, ... 315
Family II. Scleritodermidæ, ... 315
Scleritoderma, O. Schmidt, ... 315–317
Family III. Cladopeltidæ, ... 317
Siphonidium (O. Schmidt), ... 317–319
Suborder II. ANOPLIA, ... 319
Family I. Azoricidæ, ... 319
Azorica, Carter, ... 319–324
Tretolophus, n. gen., ... 325–354
Supplementary Account of Lithistida not in the Challenger Collection, . . 326–354
Family I. Tetracladidæ, ... 326
Theonella (Gray), ... 326
Discodermia (Bocage), ... 327–331
Racodiscula (Zittel), ... 331–333
Kaliapsis, Bowerbank, ... 333–334
Neosiphonia, n. gen., ... 334
Rimella, O. Schmidt, ... 335
Collinella, O. Schmidt, ... 336
Sulcastrella, O. Schmidt, ... 337
Family II. Corallistidæ, ... 338
Corallistes, O. Schmidt, ... 338–340
Macandrewia (Gray), ... 340–342
Dædalopelta, n. gen., ... 342–343
Heterophymia, Pomel, ... 343
Family III. Pleromidæ, ... 343
Lyidium (?), O. Schmidt, ... 343–344
Family I. Neopeltidæ, ... 344
Neopelta, O. Schmidt, ... 344–346
Family II. Scleritodermidæ, ... 346
Scleritoderma, O. Schmidt, ... 346–347
Aciculites, O. Schmidt, ... 347–348
Family III. Cladopeltidæ, ... 348
Siphonidium, O. Schmidt, ... 348–349
Family I. Azoricidæ, ... 349
Azorica, Carter, ... 349
Gastrophanella, O. Schmidt, ... 349–350
Setidium, O. Schmidt, ... 350
Poritella, O. Schmidt, ... 351
Amphibleptula, O. Schmidt, ... 351–352
Tremaulidium, O. Schmidt, ... 352
Leiodermatium, O. Schmidt, ... 352–353
Sympyla, n. gen., ... 353
Family II. Anomocladidæ, Zittel, ... 354
Vetulina stalactites, O. Schmidt, ... 354
IV. GEOGRAPHICAL AND BATHYMETRICAL DISTRIBUTION, ... 355–405
V. APPENDIX I., ... 407–410
Omissa, ... 407

PAGE

VI. APPENDIX II.—MONAXONIDA. . 411
Introduction and Classification. . 411–419
Relation to the Tetractinellida. . 419–421
Description of Species. . 421
Suborder III. Spirotriaenophora. 421
Group I. Homosclera. 422
Family I. Astropeplidæ. 422
Astropeplus, n. gen., 422–423
Group II. Heterosclera. 423
Division I. Cornacuspidifera. 423
Family I. Axinellidæ. 423
Epallax, n. gen., 423–425
Family II. Dorypleridæ, ... 425
Dorypleres, n. gen., ... 426
Family III. Tethyidæ, ... 427
Tethya, Lamarck, ... 427–432
Division II. Spinispirifera. 432
Family I. Suberitidæ. 432
Suberites, n. gen. 432–433
Supplementary Account of Cornacuspidifera not in Challenger Collection. 434–444
Family I. Axinellidæ. 434
Homaxinella, Carter. 434
Family II. Dorypleridæ. 434
Dorypleres, 434–435
Family III. Tethyidæ. 435
Tethya, 435–441
Chelotropha, O. Schmidt. 441–442
Myxilla, n. gen., . 442–443
Xenospongia, Carter. 443–444
List of Stations at which Spirotriaenophorous Monaxonida have been obtained, with the species from each, . . 444–445
VII. SYSTEMATIC INDEX, ... 447–455
VIII. INDEX TO AUTHORS. 457
IX. EXPLANATION OF PLATES.
X. MAP.

INTRODUCTION.

The Tetractinellida offer for our study one of the most interesting of all the groups of sponges: commencing with such comparatively simple forms as *Placina* and *Tetilla* they culminate in *Geodia* and the Stellettidæ, which are the most highly organised representatives of the Parazoa; at the same time they are connected in so nicely a graduated series as to form a highly natural group, within which the problem of tracing the evolution of structure from lower to higher stages may be attempted with much hope of success.

The singular and striking characters of the higher forms have rendered them objects of interest from very early times, so that of recent Choristids faithful descriptions will be found in the works of Donati, published so far back as 1758, and of the fossil Lithistids good accounts occur still earlier, Guettard in 1751 describing in great detail the petrified pears or fossil figs of earlier writers, now known as *Siphonia*. These he not unnaturally assigned to the Corals, a mistake that Gray was near repeating when the first described recent Lithistid (*Macandrewia*) came before him for classification.

From these early times to the present naturalists have constantly added to our knowledge of the group, but no one up to the date of the commencement of this Report has published an account of their fundamental structure, if we except the important work of F. E. Schulze on the Placinidæ and several descriptions of Astrophorous Sponges by myself; while during its progress but one memoir on the anatomy of a single form has made its appearance. Nor, considering the general inaccessibility of most of the species, is this to be wondered at; and the value of the fine collection brought home by the Challenger lies not so much in the addition of new and remarkable forms to the group, though these are not wanting, as in the presence of well-preserved examples of nearly every important genus; so that for the first time it has become possible to publish a system of the Tetractinellida founded on a knowledge of their anatomy; and only by such knowledge extending over a large series of species could a consistent system be founded with any chance of success.

Of the defects in the proposed Classification no one can be more conscious than myself; most especially do I regret the uncertainty which attends the phylogeny based

upon it, an uncertainty so great that in many cases alternative schemes of genealogy are proposed for consideration. It may be and indeed has been argued that this uncertainty is inherent in all schemes of phylogeny alike, but this is an opinion which I by no means share. Tables of phylogeny are to the biologist what constitutional formulæ are to the chemist, and the success in elucidating these which the latter has achieved in the face of opposition and discouragement, from a spirit sometimes of conservatism, and sometimes of despair, must prove an encouragement to the biologist to persevere in his efforts to attain to a rational interpretation of the facts of classification. An earnest of such success appears to me to be furnished by Schulze's genealogy of the Hexactinellida.

MORPHOLOGY.

GENERAL STRUCTURE.

In that work of genius the "Kalkschwamme" of Haeckel the Calcareous sponges (*Megamastictora*) are traced both ontogenetically and phylogenetically to a primitive Ascon-like ancestor (*Olynthus*). In the non-calcareous Sponges (*Micromastictora*) the researches of embryologists[1] have made us acquainted with a primitive ontogenetic form which may be distinguished as a Rhagon,[2] but this, unlike the Ascon, is only known in a transitory larval stage, and is not represented by any persistent adult form.

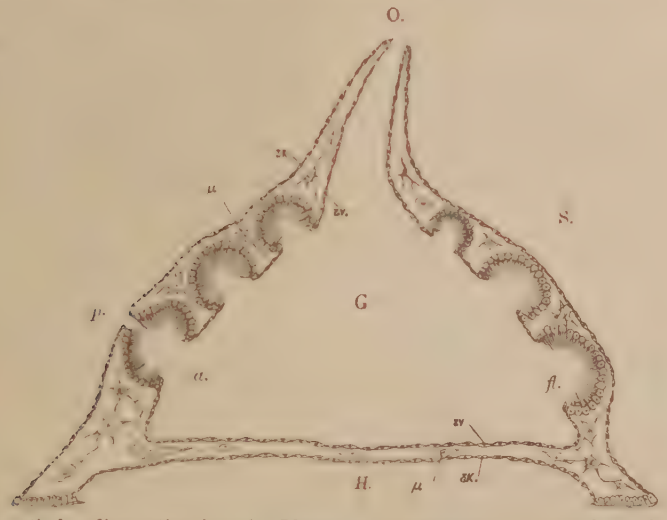


FIG. I.—Diagrammatic vertical median section through a Rhagon. S., spongophare; H., hypophare; O., oscule; G., paragastric cavity; *fl.*, flagellated chamber; *a.*, apopyle; *p.*, prosopyle; εκ., ectoderm; εν., endoderm; μ., mesoderm.

It has the form of a more or less hemispherical sac, the upper part (*spongophare*[3]) rising dome-like from a flat attached base (*hypophare*); its walls consist of

[1] Keller, *Reniera fertilis*, *Zeitschr. f. wiss. Zool.*, Bd. xxxiii. pp. 317–349, pl. xix. fig. 23, pl. xx. fig. 24; Schulze, *Placina monolopha*, *op. cit.*, Bd. xxxiv. pp. 416–423, pl. xxii. fig. 28; Heider, *Oscarella lobularis*, *Arb. Zool. Inst. Wien*, Bd. vi. pp. 1–62, pl. ii. figs. 18–20.

[2] ῥάξ, ῥᾶγος, ἡ, a grape.

[3] φᾶρος, εος, τό, a cloth, sheet, web.

three layers of tissue, the fundamental ectoderm and endoderm, and the so-called mesoderm.[1]

The mesoderm is a very thin layer, consisting of collenchyma (see p. xxxviii), the ectoderm is an epithelium of pavement cells (*pinacocytes*), and the endoderm is partly composed of flagellated collared cells (*choanocytes*), and partly of pinacocytes.

The hypophare consists of mesoderm lined by pinacocytal endoderm above, and ectoderm below; the spongophare is characterised by evaginations of the endoderm, which forms pouch-like recesses in the mesoderm, and within these it consists of choanocytes, elsewhere of pinacocytes.

The recesses, known as flagellated chambers, communicate with the cavity of the sac (*paragaster*) each by a single wide mouth (*apopyle*), and with the exterior by a small pore (*prosopyle*).

A single comparatively large opening (*oscule*) at the summit places the paragaster in free communication with the surrounding water. The oscule is not derived from the blastopore, which in the larval stage immediately preceding that of the Rhagon is situated in the centre of the primitive hypophare.

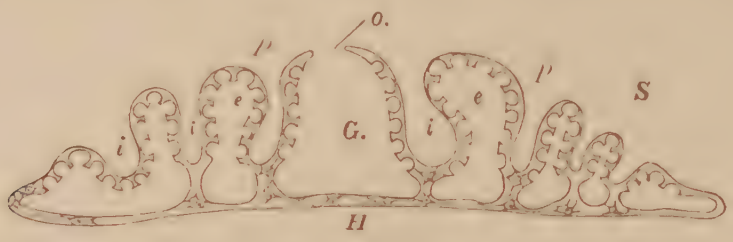


FIG. II.—Diagram of a young sponge, showing the folded spongophare. S, spongophare; H, hypophare; O., oscule; G., paragastral cavity; *e*, excurrent canal; *i*, incurrent canal; *p*, pore.

In the case of many spherical sponges which in their earliest known stages are not attached, but free, the hypophare is probably not developed at all (or possibly metamorphosed at a very early stage), the Rhagon in all probability having a spherical form and consisting wholly of the spongophare.

Doubtless the Rhagon is readily derivable from the Ascon; but it never actually passes through an Ascon stage, differing in this respect from the Sycon, from which it is also distinguished by the more spherical form of its flagellated chambers. The whole course of embryological history of the Rhagon differs from that of the Megamastictora in numerous details, and particularly in the absence of an amphigastrula stage.

The successive stages by which the Rhagon passes into the adult sponge have not been traced, but Schulze has sufficiently shown, at least in some instances, the probable course of events, which consists simply in a folding of the spongophare which proceeds

[1] These terms are used merely for convenience; it is far from certain that the tissues they denote are homologous with those similarly named in the Metazoa.

pari passu with the increase by growth of the sponge. In this way the simple structure of *Oscarella lobularis*, O. Schmidt, and *Placina monolopha*, F. E. Schulze, may be explained.

The inner sinuses of the folds or lobes of the spongophare are continuous with the original cavity of the paragaster; they and the remains of the paragaster are now known as "excurrent" canals; the outer sinuses, known as "incurrent" canals, are open to the exterior; their open ends are known as "pores."

Eurypylous Chamber-System.—The flagellated chambers continue as in the Rhagon to communicate directly with the excurrent canals through the apopyles, which are not continued into special tubes; and in all such cases, where several chambers open directly into a common excurrent canal, we shall speak of the chamber-system as "eurypylous."

The extreme simplicity which characterises the folding of the spongophare in *Placina* is not to be met with in any other genus of Tetractinellida, but it is closely approached in the case of certain species of *Tetilla* and *Thenea*. In *Tetilla pedifera*, Sollas (Pl. XLI. fig. 7), the spongophare retains the primitive simplicity of structure

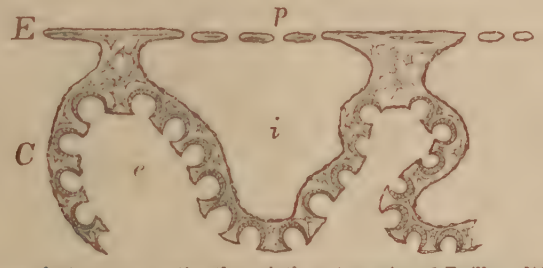


FIG. III.—Diagram of a transverse section through the outer region of *Tetilla pedifera*. E, ectosome; C, choanosome; *e*, excurrent canal; *i*, incurrent canal; *p*, pores.

it possesses in the Rhagon almost throughout the whole sponge; but it is folded to a far greater extent and in a far less regular manner than in *Placina monolopha*. This indeed follows as a necessary consequence of its immensely greater size, particularly in thickness. Furthermore, concrescence occurs wherever the folds are brought in contact, and this makes the nature of the folding more difficult to analyse.

Ectosome and Choanosome.—An additional and important modification is to be found in the presence of an investing membrane which surrounds the whole of the free surface of the sponge; it roofs over the incurrent canals which now communicate with the exterior through groups of small apertures which traverse it, and which are called "pores," though evidently not quite homologous with the apertures so designated in *Placina*; and it is confluent with the lobes of the folded spongophare where these lie immediately beneath it.

This investing skin may be distinguished as the *ectosome*, the rest of the sponge as the *choanosome*, the latter name framed in allusion to its being the region to which the choanocytes lining the flagellated chambers are restricted.

The ectosome differs completely from the hypophare, greatly as it may resemble it in general appearance. It is, to begin with, of secondary origin, and in the next place the endoderm does not enter into its composition; it consists of mesoderm bounded on the inner and outer faces by ectoderm, at least so we suppose, but there is a difficulty involved in this view that will be discussed directly.

The incurrent canals which lie immediately beneath the ectosome are now known as "subdermal cavities."

The manner in which the ectosome arises is not yet known. In such a case as that just described, it might with great plausibility be regarded as due to a lamellar outgrowth from the outer ends of the lobes of the spongophare, in a direction generally parallel with the surface of the sponge; followed by partial concrescence of the lamellæ so produced, and the consequent formation of pores as *lacunæ relictæ*.

A part of the ectosome as shown in the diagram is probably furnished by the

Fig. IV.—Diagram showing, hypothetically, the development of the ectosome. H, hypophare; S, spongophare; E, ectosome; *s*, *s*, incurrent sinuses; *l*, lamellar outgrowth of the spongophare; *p*, pores.

suppression of flagellated chambers in the outer ends of the spongophare lobes, the space which they would otherwise have occupied being filled up with mesoderm.

If this explanation could be accepted it would harmonise our views as to the morphological value of the epithelium lining the walls of the incurrent canal system, for evidently this would then correspond to the ectoderm; but at first sight it does not appear to be consistent with what little we know of the mode of formation of the ectosome. In *Spongilla* (Carter and Lieberkuhn), in *Esperia* (Carter), and in *Thenea* and *Stelletta*, the ectosome appears to arise by fission from the choanosome. It would appear that a thickening of the mesoderm takes place in the Rhagon or young sponge, and that in the middle of this cleavage occurs parallel to the outer surface, dividing the sponge at once into a choanosomal and ectosomal portion. This has already been noticed by Selenka[1] in the case of the external buds of *Tethya maza*, and has been compared by

[1] *Zeitschr. f. wiss. Zool.*, Bd. xxxiii. p. 474, pl. xxviii. fig. 12.

him to the formation of the body-cavity in the Cœlomata. Coincidently with the cleavage, the choanosome folds within the ectosome, the cleavage cavity enlarging into the incurrent sinuses (Fig. VI.), while the places where the choanosome and ectosome remain coherent mark the position of the ends of the excurrent lobes.

I have been careful to say that it appears as though the subdermal cavities arise by fission, for, on the face of it, if this apparent method of formation be the true one, it introduces great difficulties in the interpretation of the structure of the sponge on the germ-layer theory; for instance, in sponges where the supposed fission occurs, the epithelium would not be formed from the ectoderm as in *Placina*, but as an endothelium derived from the mesoderm, unless—and the supposition is improbable—an invagination of ectoderm occurs coincidently with the progress of cleavage. On the other hand a rapid invagination of ectoderm might readily be mistaken for cleavage, and the facts presented by a larval form of *Stelletta phrissens* seem to point to such an explanation. In this larva, not more than 0·65 mm. in diameter, the ectosome is already differentiated as a separate layer from the choanosome, but some of the subdermal cavities have an almost spherical form, no wider than high, and might very well result from invagination of the ectoderm; this given, the rest becomes clear; we have only to suppose that these cavities increase with the continued folding of the choanosome and the wide incurrent sinuses will be produced with of course an ectodermal lining.

In sponges next higher in the scale to *Tetilla pedifera* and *Thenea delicata*, such for instance as *Thenea muricata* and *Tetilla grandis*, the choanosome[1] is not only intricately folded again and again, but structurally modified in certain regions by the increased development and differentiation of the mesoderm and the suppression of the flagellated chambers. Thus the main excurrent sinuses or canals no longer directly communicate with flagellated chambers situated in their walls, for these chambers have become restricted to the smaller secondary or tertiary sinuses of the smaller or secondary folds, and an abundant development of mesoderm about the main sinuses has converted them into thick-walled canals.

From the walls of these canals, transverse outgrowths are developed at close but irregular intervals, and extend as thin diaphragms for a greater or less distance across the lumen; sometimes converting a canal into a succession of vesicles. These velar diaphragms, or vela as we shall briefly term them, consist of an extension of the epithelium of the canal, ectodermal or endodermal according as the canal is incurrent or excurrent, with a thin intervening layer of mesoderm. In the centre of the velum is an aperture (more rarely two) which can be enlarged or diminished by the action of fusiform muscle-cells (myocytes), which are arranged partly concentrically and partly radiately about it.

The flagellated chambers still communicate directly with those excurrent canals about which they are situated; so that the chamber-system is still eurypylous.

[1] It will be recollected that the spongophare is now differentiated into an ectosomal and choanosomal region.

Aphodal Type of Chamber-System.

In the next and by far the commonest stage of development, as met with in the Tetractinellida, a change in the character of the chamber-system occurs, accompanied by a change in the character of the mesoderm. The apopyles of the flagellated chambers no longer lie at the same level as the surface of the excurrent canal into which they open; the flagellated chambers themselves are more or less deeply removed from this surface, and the apopyle of each is continued into a longer or shorter canaliculus (*aphodus*) lined by epithelium continuous with that of the excurrent canal into which it opens. The aphodus may enter the excurrent canal either directly or after joining with one or more of its fellows (Fig. V., B).

The relations of the chambers to the incurrent canals remain at this stage almost

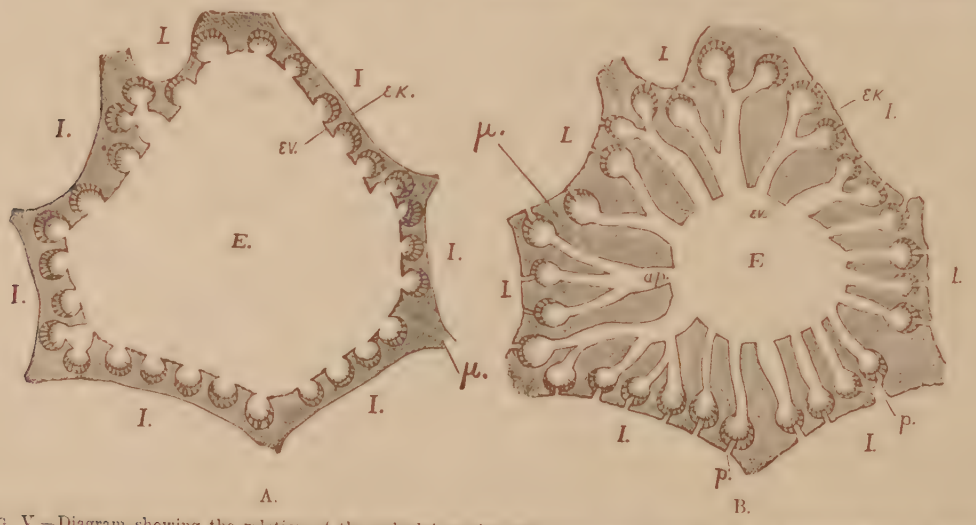


Fig. V.—Diagram showing the relation of the aphodal to the eurypylous canal-system. A. an excurrent canal (E) with eurypylous chambers opening into it. B. the same, with the lumen reduced by a growth of mesoderm which has converted the apopyles into aphodi; I., incurrent, E., excurrent canals; *p.*, prosodus; *ap.*, aphodus; *εκ.*, ectoderm; *εν.*, endoderm; *μ.*, mesoderm.

unchanged, the prosopyles still lying in the surface of the canal-wall, or if removed from it, only for a very short distance, so that the canaliculus (*prosodus*) resulting from the elongation of the prosopyle is comparatively very short. Short prosodi, it may be observed, occur even in the Rhagon.

This change in the character of the canal-system is probably due to the increased growth of the mesoderm, which encroaches upon the cavity of the excurrent canals, diminishing the lumen except in front of the flagellated chambers, the margins of which thus become produced into the aphodi, which indicate by their length the distance to which the epithelial lining of the canal has been carried from its original position.

The aphodus is evidently not produced like the excurrent canals by folding, but is

a remnant of the cavity of an excurrent sinus which has been left behind amidst a surrounding growth of mesoderm. The accompanying diagrams (Fig. V.) will serve to make this clear.

The aphodal character appears at a very early stage in the embryological history of those sponges in which it occurs; it is already perfectly displayed, for instance, in a young sponge of the species, *Stelletta phrissens*, not measuring more than 0·65 mm. in diameter (Pl. XVI. fig. 18); at the same time some of the chambers in this example retain a eurypylous character.

The change in the character of the mesoderm already alluded to as accompanying the transition from the eurypylous to the aphodal chamber-system, consists in its conversion from collenchyma to sarcenchyma (see p. xxxviii). In young sponges up to at least 3 mm. in diameter the whole of the choanosomal mesoderm consists of sarcenchyma; but in the adult sponge the mesoderm forming the walls of the larger excurrent canals is collenchymatous.

In some of the lower forms of sponges with aphodal chambers (*Chrotella simplex*, p. 17), where the aphodus is very short, the collenchyma merely becomes abundantly granular in the neighbourhood of the flagellated chambers, but in the higher forms with a fully expressed aphodal chamber-system, and these are the rule in the Tetractinellida, it is entirely replaced by a true sarcenchyma.

One other important modification remains to be mentioned; this is the relatively smaller size of the flagellated chambers that usually marks the aphodal as compared with the eurypylous chamber-system. A similar reduction accompanies the passage from the simpler to the more complicated types of eurypylous chamber-system. From these generalisations we reach one still more general, namely, that the flagellated chambers diminish in size correspondingly with increased development of the mesoderm.

In the absence of any exact knowledge of the physiology of sponges it would appear hopeless to attempt to explain this result, but the following considerations present themselves:—In the eurypylous type of chamber-system, the choanocytes work at a mechanical disadvantage, no inconsiderable part of their energy being expended in producing eddies, which in no way promote but rather interfere with the production of currents definitely directed; in the aphodal type this useless expenditure of energy is to a great extent prevented by the elongation of each chamber into a tube, which isolates the separate currents and prevents them from interfering with each other. Increased efficiency being thus acquired, the same amount of current can be produced by fewer choanocytes; and thus smaller chambers, and relatively to the bulk of the sponge fewer choanocytes, characterise the aphodal as compared with the eurypylous chamber-system. Until the volume, velocity, and duration of the currents in different types of sponges has been investigated, this explanation must be regarded as hypothetical; and still more so the following attempt to connect the change in the character of the chambers with the

increased development of mesoderm. At present we know next to nothing as to what cells in the sponge are concerned in the ingestion and digestion of food; in an Ascon we may fairly suppose that it is the choanocytes of the endoderm, for no other endodermal cells exist; in the higher sponges we have no reason to suppose that the choanocytes have lost this function, but at the same time we have no certain proof that the pinacocytal cells of the endoderm, which may be regarded as reduced or metamorphosed choanocytal cells, have lost it either; they have ceased to be agents of propulsion, but not necessarily of ingestion and digestion, indeed it is possible that with the loss of the former function the latter has become enhanced. Next it has to be noticed that the mesoderm not only increases in relative volume, but undergoes a change of character, as the type of chamber-system is raised; this change consists partly in its becoming more granular, the granules first appearing in the immediate neighbourhood of the flagellated chambers; this granulation is indicative of more active metabolism, and is probably connected with the acquisition of nutriment; it may be secretory, the mesodermal cells producing some solvent fluid, which subsequently enters the adjacent canals and breaks up the contained food into readily assimilated products, or it may be that the mesodermal cells are transformed epithelial cells, which, having obtained their share of food, have retired into the mesoderm to digest it. These and other conjectures, in the absence of exact knowledge, are open to us, but in any case we may probably connect the increased metabolism of the cells with alimentary processes; and if so, the increased development of the mesoderm is to be connected with the more granular character it presents in sponges with aphodal chambers. To render this conjectural explanation clearer, we may add a hypothetical account of the succession of events which led from the eurypylous to the aphodal type of chamber-system,—a change which has occurred independently in different groups of sponges, and which must be susceptible of a physical explanation. Commencing with a eurypylous chamber, we may suppose that some of the choanocytes near its mouth became transformed into pinacocytes, which acquired increased powers of ingesting and digesting food, this led directly or indirectly to an increased growth of mesoderm in their immediate neighbourhood; and consequently to a change in the form of the flagellated chamber, the apopyle of which became produced into a short tube or aphodus; from this followed increased efficiency in current-producing power, eddies being reduced; a further change in the same direction continued till the relative dimensions of chamber and aphodus were those of maximum efficiency.

Diplodal Type of Chamber-System.

The final stage in the modification of the chamber-system is that in which the incurrent canals, as well as the excurrent, are encroached upon by the mesoderm. The mesoderm increasing in thickness, reduces the lumen of the incurrent canal and the

prosopyle becomes continued into a comparatively long prosodus. This, which may be called the diplodal type of chamber-system, is rarely met with among the Tetractinellida, or indeed in the Parazoa generally. Schulze[1] describes it in *Corticium candelabrum*, O. Schmidt, and I have met with it in *Thrombus challengeri* and *Azorica pfeifferæ*. It appears to correspond to Vosmaer's fourth type of chamber-system.[2]

Since the progressive change from one type of chamber to another is associated with a change in the characters of the mesoderm and its increased development, we might expect some marked differences, evident to the unaided senses, in the general character of sponges distinguished by different types of chamber-system. Such differences certainly do exist, but they are of little value to the investigator. On the whole sponges with eurypylous chambers are less dense, and those with diplodal chambers denser than those with aphodal chambers. Sponges with diplodal chambers are usually remarkably compact and "fleshy."

The characters of the chamber-system are most easily determined in the eurypylous type: in sponges belonging to it the chambers are sometimes clearly displayed in thick slices cut free hand from a spirit specimen, with no further preparation than staining and mounting in glycerine.

The Ectosome.

The change in the character of the canal-system is usually but not invariably (*Thrombus* and *Azorica* are exceptions) accompanied by considerable modifications of the ectosome. These appear to be of different nature in different sponges, and even when the final products are structurally similar, they may have been differently evolved.

Embryological evidence as to the precise history of the ectosome is however scanty, and consequently the following explanation must be regarded as to some extent hypothetical.

In sponges with eurypylous chambers the ectosome never attains any high degree of differentiation. It consists, as shown in the diagram (Fig. III., p. xv), of an investing membrane composed of a thin layer of mesoderm bounded on both sides by ectodermal epithelium, together with the metamorphosed ends of the excurrent lobes, which place the outer membrane in continuity with the rest of the sponge; these metamorphosed ends we shall speak of as the pillars of the subdermal cavities. The external or dermal membrane may attain a thickness of nearly a millimetre and sometimes presents considerable histological differentiation; but the subdermal cavities are never completely differentiated from the incurrent canals, and always communicate directly with more or fewer of the flagellated chambers (Pl. I. figs. 12, 27; Pl. VII. fig. 4; Pl. VIII. fig. 9).

[1] Schulze, *Zeitschr. f. wiss. Zool.*, Bd. xxxv., 1881.

[2] Vosmaer, Bronn's Klassen u. Ordnung. d. Thierreichs, Porifera, p. 131, fig. 7.

In the simplest sponges with an aphodal chamber-system, such as *Myriastra* (Pl. XII. figs. 24–27) among the Stellettidæ, the ectosome does not markedly differ from that already described, but in genera only slightly removed from this, such as *Pilochrota*, it exhibits in different species a surprising diversity of structural detail. The first advance appears to consist in a growth of the mesoderm, leading to a thickening of the pillars of the subdermal cavities, and to the extension inwards of processes from the dermal membrane. In this way the greater part of the subdermal cavity may become obliterated, special interspaces or canals being left, through which the pores communicate with the incurrent canals. The growth of the mesoderm is accompanied by structural differentiation; additional fusiform cells make their appearance, especially in the lower layer of the ectosome, *i.e.*, that next the choanosome, and these increase in number till they form dense fibrous bundles, which cross each other in all directions, chiefly parallel to the surface, and so produce a thick fibrous felt. The ectosome is thus differentiated into two regions or layers, an outer chiefly collenchymatous, and an inner chiefly fibrous. As in the dermal membrane of *Tetilla pedifera*, a thin layer of fusiform cells, probably myocytes, is present immediately beneath the outer epithelium of the surface of the sponge.

In this and further stages of development the ectosome is known as a cortex.

In some species of *Pilochrota* (*Pilochrota pachydermata*, *Pilochrota gigas*), the development of fusiform cells continues till the cortex becomes entirely fibrous throughout (Pl. XXXVIII. fig. 25). Striking as is the difference in general appearance of a wholly fibrous cortex and one in which the outer moiety consists chiefly of collenchyma, it is a character of no special significance, at all events in classification; thus in the Monaxon genus *Tethya*, closely allied, almost identical, species may present, the one a cortex consisting of an outer collenchymatous and inner fibrous layer (*Tethya seychellensis*, Pl. XLIV. fig. 4), and the other a cortex fibrous throughout (*Tethya ingalli*, Pl. XLIV. fig. 16). This difference in the cortex is not, however, without its effect on the character of the intercortical cavities; in the last named or entirely fibrous cortex these cavities are usually simple cylindrical tubes extending directly across the cortex from the pores or pore-sieves to the incurrent canals of the choanosome (Pl. XLIV. fig. 14); in cortices with an outer collenchymatous layer, on the other hand, the cavities remain simply tubular within the fibrous region only, but within the collenchyma extend laterally parallel to the surface, burrowing through it as branching canals (Pl. XL. fig. 8), or widely excavating it as continuous chambers (Pl. XL. fig. 3).

In sponges with a well-developed cortex, the intercortical canals are usually of a very definite character (Pl. XL. figs. 3, 8; Pl. XXI. figs. 9, 29), and at their inner end, where they communicate with or pass into the incurrent canals, they are usually provided with a muscular sphincter, which represents an over-developed velum. They have been called "chones," and distinguished into an outer part which extends from the

sphincter to the investing epithelium of the sponge (ectochone), and an inner which extends from the sphincter to inner limits of the cortex (endochone). The endochone is more frequently absent than present; its existence depends on the position of the chonal sphincter; if this lie in the same plane as the inner limit of the cortex there will of course be no endochone. I think, therefore, the distinction between ecto- and endo-chone may as well be suppressed, the existence of an endochone when present being expressed by the statement that the chonal sphincter is situated at such and such a level within the fibrous layer of the cortex. In some cases, however, the terms ectochone and endochone will be met with in the descriptive part of the Report.

Beneath the cortex and lying in the choanosome there occur in many sponges large lacunar cavities, into which one or more, usually more, of the chones open, and from which the incurrent canals take their origin. These cavities are the subcortical crypts.

The homology of the chones and subcortical crypts has not yet been investigated; Vosmaer[1] has thrown doubts on the equivalence of the chones of different families, and Marshall[2] has suggested that the subcortical crypts are equivalent to subdermal cavities. The subject is a difficult one, but in two cases, which are probably typical, the evidence seems fairly clear.

Type 1. *Stelletta phrissens*.—In very young examples of this sponge the choanosome is to be seen distinctly folded within a thin investing ectosome or dermal layer, no more advanced in character than say that of *Tetilla pedifera*; the outer sinuses of the choanosomal folds represent both subdermal cavities and incurrent canals, for these are not at this stage differentiated from each other. In more advanced specimens the ectosome, still bearing the same relation to the incurrent sinuses and the choanosome, is converted into a comparatively thick cortex which consists chiefly of collenchyma, faced on its inner surface by a layer of fibrous tissue (Pl. XVI. fig. 20). Large cylindrical canals traverse this cortex and give rise to the chones of the adult sponge; while the subcortical crypts arise from the incurrent sinuses, and are clearly homologous with the subdermal cavities of *Tetilla* and other sponges. The chones on the contrary are clearly of independent origin, secondary cavities formed within a cortex, which may be regarded as produced by a centrifugal growth of a simple dermal membrane. At

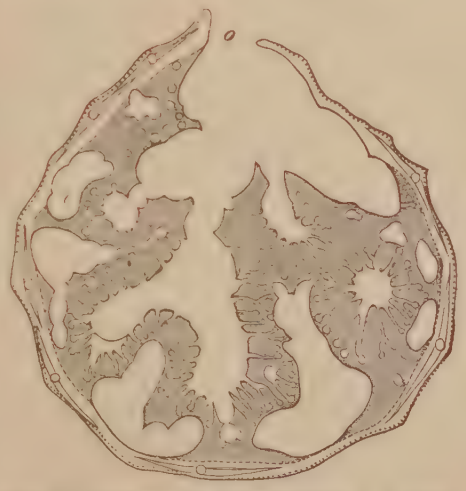


FIG. VI.—Longitudinal median section of a young *Stelletta phrissens*, showing the choanosome folded within the cortex; *o*, oscule.

[1] Bronn's Klassen u. Ordnung. d. Thierreichs, Porifera, p. 126, 1887.
[2] Zool. Jahresber. Neapel, p. 186, 1880.

the most they can only be regarded as centrifugal extensions of the subdermal cavities.

To this type the cortex of the Geodiidæ may be assigned, as will appear from observations on a young Geodine sponge described later.

Type 2. *Craniella simillima*.—An altogether different history is presented by the cortex of this sponge. In the adult, however, the cortex appears to be exactly homologous with that of *Stelletta phrissens*. It consists (Pl. II. figs. 12, 13) of (1) a thick fibrous inner layer, crossed by cylindrical canals, sphinctrate at their inner ends, and (2) a thick outer collenchymatous layer widely excavated by extensive cavities, which are large and continuous in the young sponge, but in older examples become subdivided by a rich development of trabeculæ, which increase in thickness till they reduce the originally simple cavity to a collection of lacunar spaces. The first-mentioned layer (1) would naturally be regarded as equivalent to the inner fibrous layer with that portion of the chones traversing it in the cortex of *Stelletta*; the second (2) to the outer collenchymatous

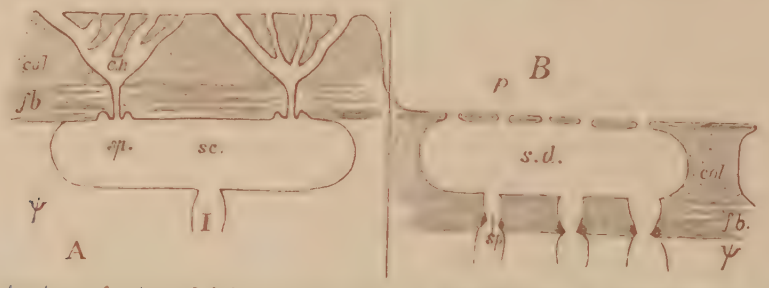


FIG. VII.—The two types of cortex and their associated canals. A. Stellettid type. B. type of *Craniella*. *sc.*, subcortical crypt; homologous with *s.d.*, subdermal cavity; *col.*, collenchymatous layer of the cortex; *fb.*, fibrous layer; ψ, choanosome; *ch.*, chone; *p.*, pore; *sp.*, sphincter.

layer of that cortex and the outer ends of several chones run together. Such, however, is not the case.

In the youngest observed specimens of *Craniella simillima*, taken out of the parent and measuring 1·4 by 2·4 mm. in length and breadth, the cortex is subdivided into two regions, one of which, partly fibrous and much the thicker, is continuous with the choanosome, from which it evidently arises by metamorphosis; the other forms a thin investing membrane separated from the inner thicker layer by wide and deep cavities, which are evidently the widely extended superficial ends of the incurrent sinuses or true subdermal cavities (Pl. II. fig. 19). In this case the cortex is evidently of a composite nature, consisting partly of the dermal membrane, partly of the metamorphosed ends of the excurrent lobes of the choanosomal folds; in *Stelletta*, on the other hand, the cortex is derived entirely from the dermal membrane by a thickening and differentiation of its mesoderm. The chones consequently are secondary formations, and the intercortical cavities of *Craniella* are not homologous with them but with the subcortical crypts.

This result leads us to a further critical examination of the intercortical cavities of the fully grown sponges: and from it I am inclined to think that the following differences will be found to obtain generally, though perhaps not universally.

In *Sollasella*, *Geodia*, and their allies the intercortical cavities are separate and independent closes, which when traced centripetally are frequently found to open into a common subcortical crypt (Pl. XXVII. fig. 13). In *Craniella* the intercortical cavities form large subdermal chambers, which when traced centripetally are found to lead each into several separate and independent incurrent canals. The relations of the two types to each other are shown on the accompanying diagram (Fig. VII.).

The Canal-System.

The spongosphere or choanosome as the case may be is folded on very different plans in different sponges, and these are expressed in the different disposition of the incurrent and excurrent canals. The arrangement of the main canals has been spoken of by Zittel as the type of canal-system, a convenient expression which has been unfortunately rendered ambiguous by other writers, since they have used it to denote the nature of the relations of the flagellated chambers to the ultimate branches of the incurrent and excurrent canals. As, however, Zittel's use of the term seems the more appropriate, and to have priority, I shall retain it in his sense, and replace it as used in the other sense by the term "type of chamber-system."

The details of the canal system can seldom be clearly traced, since in all but the youngest or smallest sponges they are obscured by metamorphosis and concrescence. No doubt a study of young examples of the larger sponges, in various stages of growth, will enable us to unravel many of the complexities presented by the adult, but this will be a laborious task, and one for which the Challenger material is not adequate. The study of this subject involves also a knowledge of the manner in which the adult increases in size, and regarding this we are at present ignorant; is growth merely additive, occurring chiefly at the superficies, or is it to any great extent also interstitial? So far as increase in size is generally concerned, I am for many considerations strongly inclined myself to regard it as mainly exogenous, occurring chiefly in a zone immediately beneath the ectosome; but that interstitial growth does also occur is certain, as observations made on the distribution of the spicules in the cloacal tube of *Tribrachium schmidtii* prove (see p. 157), the cladomes of these spicules becoming more removed from each other as they are traced from the origin of the tube towards its termination, and this can only be due to interstitial growth.

As our knowledge is so evidently limited, this chapter must be regarded rather as pointing out questions for investigation than a summary of positive results.

Canal-System in Placina.—The simplest type of folding producing the simplest type of canal-system is that already described by Schulze as occurring in *Oscarella lobularis*, O. Schmidt, and *Placina monolopha*, F. E. S. The term folding as used here and by Schulze is not altogether free from objections, and in many cases the process might be better described as evagination or invagination; thus the folds of *Placina* may be described as vertical tubular outgrowths or evaginations of the spongophare; such evaginations remind one of the radial tubes of the Sycones, which Haeckel regards as produced by gemmation; fundamentally evagination and gemmation are much the same thing, and the question is chiefly one of terms.

Canal-System in Sponges with plate-like Walls.—In no other known Tetractinellid sponge is such a simple canal-system as the preceding met with; the nearest approach to it—*longo intervallo*—is made by *Epallax callocyathus*, a vasiform sponge with a lamellar wall. As in most other plate-like sponges, the oscules are distributed in a fairly regular manner on the concave side of the plate, the pores in sieves on the convex or outer side; a transverse section reveals two, apparently ectosomal, layers, one forming the oscular and the other the poriferous face of the sponge; between these two layers is a regularly folded sponge plate (Pl. X. figs. 10, 11); its folds, however, have not the simple structure of *Placina*, but are themselves folded, the flagellated chambers opening into the sinuses of the secondary folds; further, they are only apparently folds, tangential sections showing in this case, as in *Placina*, that the apparent folds are really tubular evaginations with a circular lumen. Simple as this structure undoubtedly is, yet in the absence of embryological evidence it is by no means an easy task to derive it from the original Rhagon. Our first step will be to determine the homology of the two superficial layers; that forming the poriferous face is evidently ectosomal, that forming the oscular face probably not. What is the nature of the epithelium of the oscular face? Is it ectodermal or endodermal? If endodermal, then the cavity of the vase forming the sponge must be paragastral. The vase-like form however is not essential, and in other plate-like sponges seldom exists except as a secondarily acquired character; if then we seek to explain the more general case of a flat plate-like sponge on the assumption that the epithelium of the oscular face is endodermal, we shall have to imagine that it originated from the Rhagon by an opening out of the latter, the oscule of the Rhagon expanding till its margin became the margin of the plate, and its paragastral surface flattening till it became the oscular face; this is a possible explanation, and, adopting it in an article on Sponges published elsewhere,[1] I have called the superficial layer of the oscular face an endosome. Another explanation, however, may be advanced. Let us regard the epithelium as ectodermal, the superficial layer of the oscular face will then consist of an outer ectodermal, an inner endodermal, and a middle mesodermal layer, in other words it is not an endosome but a hypophare. We may thus compare

[1] Encyclopædia Britannica, 9th ed., art. Sponges, p. 415.

Epallax in general terms to a *Placina* detached from its seat, turned sideways up, and furnished with additional oscules opening through the hypophare, one for each excurrent sinus. In *Placina* the roots of the excurrent evaginations are continued into the hypophare by trabeculæ, these are present in *Epallax*, simulating the pillars of subdermal cavities. The addition of an ectosome and of secondary folds or invaginations in the walls of the main ones has already been mentioned.

In other plate-like sponges (*Pœcillastra*, *Astropeplus*, among the Choristida, *Azorica*, *Corallistes*, among the Lithistida) the plan of the evaginations is not so clearly displayed as in *Epallax*, but that it is very much of the same nature appears from the fact that the oscules and pores are similarly distributed, and that the excurrent and incurrent canals run more or less transversely across the plate. In some massive sponges, which have originated in plate-like forms, such, *e.g.*, as *Pachastrella abyssi*, it would appear as though the evagination proceeded on a similar plan.

Canal-System in Spherical Sponges.—In small spherical sponges, such as *Myriastra clarosa*, and in young examples of *Stelletta*, the axes of the evaginations radiate towards the periphery; as a consequence, from those excurrent canals which open nearest the margin of the oscule and are consequently the most superficial, secondary evaginations proceed radially towards the surface, while those which open nearer the centre of the oscule and run almost axially through the sponge, frequently expand at their distal ends into more or less concentric canals, from which again radial canals proceed towards the surface. In *Stelletta phrissens* the evaginations, at first radial, appear at a very early stage to curve round spirally, so as to acquire a more or less concentric arrangement (Pl. XVI. fig. 19); subsequently, no doubt, radial canals proceed from them, but in the fully grown sponge it is difficult to discover any definite arrangement. In most spherical sponges a general tendency towards a concentric and radiate arrangement of the canals is, however, observable, and the concentric arrangement is shown in an illustration given of part of a radial segment of *Anthastra communis* (Pl. XIII. fig. 8), where concentric excurrent and incurrent canals are shown alternating with each other.

Excurrent without corresponding Incurrent Canals.—In many sponges in which the oscules are collected in a special area (*Synops vosmaeri*, Pl. XXIII.), or in which numerous excurrent canals open into a common cloaca (*Caminus spheroconia*, Pl. XXVII.), the primary excurrent canals are without corresponding incurrent canals; if now we return to the Rhagon we shall find that every incurrent canal derived from it must by the nature of the case involve the existence of a corresponding excurrent canal, but there is one excurrent canal that does not involve the existence of a corresponding incurrent canal, and this is the remains of the paragaster itself; it would thus appear probable that each of the large excurrent canals in the case under consideration represents the remains of a paragastral cavity, produced by a process of budding from the margin of

the primitive paragastral canal, and subsequently from the margins of the apertures of the derivative canals.

Canal-System of the Siphonia type.—This remarkable type of canal-system is met with in such widely differing sponges as the fossil Lithistid *Siphonia*,[1] which is represented in the Challenger collection by the recent species *Eusiphonia superstes*; a Monaxonid sponge, *Petrosia* (*Siphonia*) *typa*, Blainville,[2] which from the remarkable resemblance of its canal-system to that of *Siphonia* was mistakenly identified by Blainville with that sponge, and in *Taxoploca* (*Emploca*) *orata*[3] a fossil Hexactinellid sponge. In these and similar sponges the form is more or less ovate or cylindrical, and the main excurrent canals radiate from an axial cloaca, which opens in an apical oscule; those that proceed from the base of the cloaca continue its direction downwards, those from the sides extend outwards and downwards in curves which become more parallel to the surface the nearer they approach it; these longitudinal curved canals have all originated at the surface of the sponge, and those now lying deep within it serve to indicate its lines of growth; since they have originated along meridians of the surface of the sponge these canals may be termed "meridional." They are of the same nature as those discussed in the last paragraph, *i.e.*, paragastral; whether they are formed as an evagination of a sponge-plate or simply of the endoderm, is not certain, but that they are either one or the other follows from the following considerations,—in the first place if the skeleton of a fossil *Siphonia*, or of a recent *Neosiphonia*, be examined it will be found that the most superficial canals are incomplete on the outer side, forming mere grooves which extend from the margin of the oscule over the adjacent surface, those lying a little deeper are converted into complete canals adjacent to the oscule, into which they open by completely circumscribed apertures, but come to the surface further away from it as grooves, and so terminate; from these observations it follows that the meridional canals originate near the margin of the oscule and subsequently extend towards the antoscular pole. If next a spirit specimen of a Lithistid presenting this type of canal-system be examined, it will be found that the most superficial excurrent canals proceed from the oscule as subdermal cavities, bounded below by choanosome and externally by ectosome, and are unprovided with corresponding incurrent sinuses; it is difficult to explain them as foldings, and in all probability they are outgrowths of the endoderm. That the deeper-lying canals were originally superficial is shown by breaking up a specimen of a recent *Neosiphonia* or *Petrosia*, when it will be found that successive concentric layers can be peeled from these sponges, each layer as it is removed exposing a previously existing surface; the meridional excurrent canals are exposed at the same time, and they are always found to lie conformably with the surface on which they appear.

[1] Sollas, *Quart. Journ. Geol. Soc.*, vol. xxxiii. p. 805, pl. xxv., 1877.

[2] Sollas, *tom. cit.*, p. 795.

[3] Sollas, *op. cit.*, vol. xxxix. p. 541; as I find that the name *Emploca* was preoccupied at the time I adopted it, I take this opportunity to substitute for it another—*Taxoploca*.

In addition to the meridional canals, a second set of more or less radial canals, crossing the others more or less transversely, characterise this type of canal-system. The most marked of these radial canals originate at the general surface of the sponge, their circular mouths being generally and without order scattered over the exterior; these no doubt are incurrent in function; others, which are not so long as the foregoing, can be traced into the meridional canals and are evidently excurrent; it is only the incurrent canals that need engage our attention, for these are without corresponding excurrent, as the meridional excurrent canals are without corresponding incurrent ones; this naturally suggests the inquiry whether the radial incurrent canals may not really represent the missing companions of the meridional excurrent canals? In reply, I will only say that I leave it to any one who thinks so to work out the details of this reconciliation. To my mind these radial canals are to be regarded as special ectodermal invaginations, or as incurrent canals, which originated in the usual way, but which by a kind of prepotency have continued their existence through several successive generations of meridional canals.

Canal-System in Thenea.—In *Thenea* we seem to meet with a special case of the foregoing type; longitudinal or meridional excurrent canals proceed from a cloaca, which opens in an oscule at the summit of the sponge, and in addition to the smaller incurrent canals, which enter the sponge from the surface generally, others of a much larger size, which originate in a special equatorial recess, are present, and these entering the sponge in an obliquely inwards and upwards direction, interdigitate with the corresponding excurrent canals descending from the cloaca; it is to be observed that the equatorial recess and the canals proceeding from it are not present in young examples of the sponge, and that in some species (*Thenea fenestrata*, O. Schmidt), in which the recess is restricted to one or more small areas in small specimens of the sponge, additional areas are added with growth; it would, therefore, appear that in this case the equatorial recess is to be regarded as a series of overgrown incurrent canals or subdermal cavities, for morphologically there is no distinction between these two in this sponge. No doubt similar poriferous recesses in other sponges, such as the Desmacidonidæ, are to be similarly explained. In *Thenea*, however, an interesting relation exists between these recesses and the habit of the sponge; it always grows in a definitely fixed position, the oscule is always uppermost, and the antoscular surface faces the sea-floor, to which it is usually attached by rooting fibres; further, the sponge is a characteristically deep-water form, and presumably therefore is surrounded by tranquil water, not disturbed by currents; given these conditions it is obvious that the water most richly laden with food will be that which the sponge inhales by its equatorial surface, and if, as seems very possible, the ectoderm as well as the endoderm is an ingestive layer, the canals through which this water enters will be better fed than the others, and tend, therefore, to a preponderant growth; by this specialisation of the

equatorially situated canals the currents setting equatorially are strengthened, and thus the sponge as a whole is benefited, since water lying on the surface of the sea-floor is skimmed off over a greater area than would otherwise be the case.

Canal-Systems possessing Radiate Symmetry.—In some few sponges the larger canal-folds are formed on a symmetrical plan, which is constant for the species. Thus in the youngest known examples of *Disyringa dissimilis*, we meet with four symmetrically arranged longitudinal excurrent canals, and four incurrent canals regularly alternating with them (p. 170, Pl. XLI. fig. 4). This points to a folding of the choanosome in the manner shown in the diagram (Fig. VIII. 1). Subsequent to the folding we may suppose that the sinuses of the folds became converted into canals by concrescence at their roots (Fig. VIII. 2).

It would appear as though the folding in this case were brought about by four invaginations of the ectoderm, commencing in one situated at the antoscular pole, whence they proceeded, burrowing beneath the ectosome, in a meridional direction to-

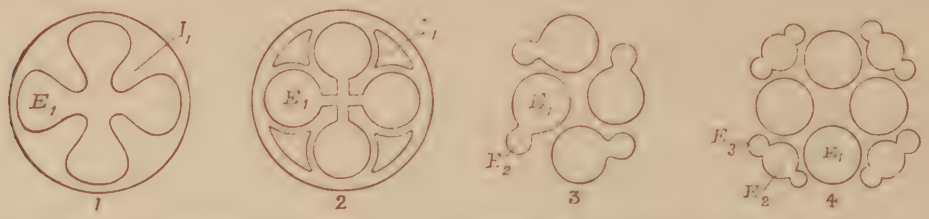


FIG. VIII. Diagram in explanation of the origin of the symmetrically arranged canals in *Disyringa dissimilis*. 1. Primitive folding of the choanosome, produced by the invagination of four incurrent canals (I), and leading to the formation of four primitive excurrent sinuses (E). 2. Stage in which the sinuses have been converted into canals (E_1) (1 and 2 are imaginary sections taken through the body of the sponge). 3. Stage in which secondary excurrent canals (E_2) occur as outgrowths of the primary. 4. Stage in which tertiary excurrent canals (E_3) are budded off from the secondary (3 and 4 are imaginary sections taken across the cloacal tube).

wards the oscule. With increased growth additional excurrent canals appear, and these are symmetrically arranged with respect to the four primitive canals, lying in the cloacal tube in the angles between them; how they are directed in the body of the sponge we do not know, since of this stage only the cloacal tube is known. In *Siphonia* we have already had reason to suppose that additional excurrent canals arise by a kind of budding from the endoderm of the cloaca, and the origin of the additional canals in the sponge under consideration may be similarly explained (Fig. VIII. 3).

Finally, eight additional excurrent canals appear, and these may be explained as paired outgrowths of the secondary ones (Fig. VIII. 4).

The symmetrical arrangement of the canals in *Disyringa*, or rather in the closely related sponge, *Agiardiella schultzii*, has been adduced by Marshall in support of the hypothesis that the sponges are degraded Cœlentera. These sponges are, however, somewhat highly specialised members of the Stellettidæ, a family by no means primitive itself and one which in no other instance displays any tendency towards special

symmetry. Since this is the case we may, with great probability, regard the symmetry in these exceptional cases as of secondary origin, as it is indeed in the Cœlentera themselves.

Symmetrically arranged canals occur, however, in simpler sponges than the Stellettidæ; in the genus *Tetilla* two instances are known of it—in *Tetilla radiata*, Selenka, and *Tetilla japonica*, Lampe; but the symmetry is not constant within the genus nor in *Tetilla radiata* even within the species; thus Selenka states that, although eight canals are usually present in this sponge, yet that seven and nine also occur; in *Tetilla japonica* there are, according to Lampe, six symmetrically arranged chief canals, but no statement is made as to the number of specimens in which this obtains.

A remarkable parallelism exists between the radiate symmetry of the sponges and the Cœlentera; a symmetrically folded *Tetilla* bearing very much the same relations to an Ascon or a Rhagon as an Actinozoon to a Hydrozoon. The ultimate cause of folding in both is probably to be found in a relatively more rapid growth of the best-fed layer: the endoderm primitively in both, in special cases, at all events among the sponges, the ectoderm also; the symmetry of the folding probably depends on mechanical conditions at present obscure, but possibly related to a symmetrical distribution of lines of weakness dependent on the form of the organism.

The Oscule.

The Paragastrula, as first shown by Metschnikoff[1] and Carter,[2] attaches itself by the oral pole and the primitive mouth or blastopore then becomes obliterated. Subsequently the oscule appears at the aboral extremity of the Rhagon as a secondary opening.

The relations of the primitive oscule of the Rhagon to that of the adult sponge are at present involved in obscurity, as also is the mode of formation of additional oscules in those sponges that possess more than one. The latter subject has indeed not even been alluded to, probably on account of the difficulties with which it is surrounded; the homology of the oscule has received much more attention, most recent writers treating of it, though generally rather by implication than as a matter for separate investigation. The most usual view appears to be that the persistent oscule is seldom directly descended from that of the Rhagon, at all events not in those cases where it forms the mouth of a cloaca. The evidence on which this view is founded appears to me to be very insufficient.

In very young spherical sponges of the species *Stelletta phrissens* (see woodcut, Fig. VI. p. xxiii), the folding of the choanosomal plate gives rise to several excurrent canals which open into the remains of the paragaster, and this communicates with the exterior through the original oscule. This arrangement is so similar to that

[1] Metschnikoff, *Zeitschr. f. wiss. Zool.*, Bd. xxiv. p. 2, pl. i., 1874.

[2] Carter, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xiv. p. 14, pl. xxii. fig. 28 (sep. copy), 1874.

which persists in such adult spherical sponges as *Myriastra clavosa*, and in comparatively large but not fully grown specimens of *Geodia barretti*, that one can scarcely refrain from regarding them as comparable. That other observers have taken a different view is due to the remarkable structural similarity of the wall of the cloaca and the cortex; this similarity has been taken for identity, and the cloaca consequently regarded as of secondary origin produced by an invagination of the cortex. The similarity does not however amount to identity, and another explanation is possible; for if we refer to the young examples of *Stelletta phrissens* just mentioned we shall see how by a very natural process a cloacal wall similar to that of a cortex will arise by modification of the roots of the choanosomal folds, for these like the rest of the primitive folds will with the growth of the sponge suffer a metamorphosis, by which the flagellated chambers will disappear from them, and the mesoderm, increasing in volume, become converted partly into collenchyma and partly into fibrous tissue. Vela which appear generally throughout the excurrent canals will also arise about their terminations in the undivided remains of the paragastric cavity, which thus will become surrounded by a distinct wall, the complexity of which may be increased by the addition of a second series of vela behind those first formed (Pl. XII. figs. 23, 40); in this way a structure remarkably like that of a cortex will result. The cloaca in this case will represent the remains of the original paragastric cavity, and thus the subsequent formation of meridional excurrent canals, as in *Siphonia*, by an outgrowth from the cloaca becomes intelligible.

In fully grown specimens of *Geodia barretti* what appear to be the oscules of the sponge form a group over a scarcely depressed area, which is surrounded by a very distinct raised marginal ring; the appearance is such as to naturally lead to the suggestion, which has been made, that we have here a case of commencing invagination of the cortex, the marginal ring representing the future margin of the commencing cloaca; the history of the sponge shows, however, that so far from this being the case the exact opposite is true, the marginal ring is directly descended from the margin of the oscule of a previous stage and the apparent oscules are the openings of excurrent canals which originally discharged into a tubular cloaca; so far from being a cloaca in process of formation this structure is a disappearing cloaca,—a cloaca which by lateral expansion has become converted into a shallow depression.

In conclusion, it would appear that in most cases the oscules of such sponges as possess only one of these openings are directly descended from that of the Rhagon, as the cloaca is the direct descendant of the original paragastric cavity. As instances I may cite the following:—*Tetilla sandalina* (Pl. I.), all the species of *Thenea* and of *Myriastra*, *Theonella swinhoei* (Pl. XXIX.), *Siphonia*, and *Neosiphonia superstes* (Pl. XXXI. fig. 7). In the case of sponges like *Jerea*, which differs from *Siphonia* in not possessing a cloaca, we must suppose that the original cloaca has disappeared, or is only represented by the

plane surface on which the excurrent canals open; the openings of these canals for convenience are called oscules, but they are really homologous with the mouths of derivative excurrent canals.

The Oscules of Compound Sponges.—In compound sponges characterised by the presence of more than one evident oscule—and all simple sponges are liable to become compound—we may regard each oscule as indicating a separate system of canals and thus in a sense as a sign of individuality. The origin of additional individuals may be attributed to a process of budding or internal gemmation from some excurrent canal running near the surface of the sponge, close beneath the ectosome, and thus serving as a kind of internal stolon.

The Pores.

These which are the immediate openings of the incurrent canals through the investing epithelium to the exterior are always very small, usually about 0·05 mm. in diameter, sometimes much less, 0·008 mm. in *Psammastra murrayi*, sometimes much more, 0·32 mm. in *Thenea wyvilli*. They are either uniformly dispersed over the poriferous surface or collected in sieve-like groups, or they form the single openings of chones. Sometimes they are more numerous over special areas, or indeed restricted to them.

Since they naturally can only occur over the subdermal cavities or intercortical canals of the sponge, one would not expect to find them generally distributed, yet this does occasionally happen when the cavities immediately beneath the skin are of great superficial extent, *e.g.*, in *Caminus sphærocomia* (Pl. XXVII. fig. 2), but more usually even in such cases they are collected into sieves, of which numerous examples are described in the body of the Report (p. 143, Pl. XV. fig. 20; p. 232, Pl. XXII. fig. 14; Pl. XXX. fig. 3). In the Geodiidæ they commonly occur as sieves over the distal ends of the chones, the roofs of which may then be said to be *cribriporal* (Pl. XL. fig. 4); but in some of the more specialised genera—*Erylus* (Pl. XXVIII. fig. 17), *Isops*,—there is but a single pore to each chone; in this case the poral roof may be distinguished as *uniporal*. The restriction of the pores to special vestibules occurs in the Tetillid genus *Cinachyra* (p. 27, Pl. XXXIX. fig. 1); in the Stellettid *Disyringa* they are confined to an extension of the cortex, which forms a special incurrent tube (p. 163, Pl. XLI. fig. 3); in other sponges, such as the *Theneæ*, special poriferous recesses are present in addition to pores generally distributed.

Lipogastrism and Lipostomy.

In many sponges the oscules are not distinguishable from the pores (lipostomy), and in some cases all traces of the paragastric cavity have also disappeared (lipogastry).

Some clue to the nature of this disappearance is possibly furnished by the Stellettid, *Myriastra clavosa*. In this sponge an oscule constantly exists (Pl. XII. fig. 40); but in many cases its aperture is so much diminished by the growth of its margin towards the centre as to be invisible to the unaided eye, or even when examined under a simple lens; indeed recourse must be had to serial sections for its discovery. The existence of a main excurrent canal can also only be ascertained by means of such sections. In *Anthastra communis*, a sponge very similar in general character to *Myriastra clavosa*, all traces of an oscule have disappeared, and the main excurrent canals cannot be traced to any common point of union beneath the cortex.

A comparison of the two sponges leads to the suggestion, that in instances of *Myriastra clavosa* with a very small oscule, we have an indication of a passage towards the condition presented by *Anthastra communis*. The chief excurrent canals in the former extend at their centrifugal ends very near to the ectosome, a little more and they would penetrate it, and open to the exterior. If this should take place a second oscule would be produced, and if it were closed by a sieve-plate, as it probably would be, it would be indistinguishable from the pores: the main branches of the excurrent canals might similarly penetrate to the exterior and several oscules result; the condition of things presented by *Anthastra communis* would thus be brought about.

Unless the original oscule of a young sponge continues to increase in size with the growth of the sponge, some such change in character as the foregoing might almost be predicted, and in *Myriastra clavosa*, so far from increasing it actually diminishes in many cases. The result of this is to lead to an increase in the water-pressure on the walls of the excurrent canals, and knowing how amenable tissues of all kinds are to the pressure, it will not surprise us to find an elongation of the centrifugal ends of the excurrent canals taking place in consequence.

In many cases the oscule is not lost, so much as transformed, its originally simple opening being replaced by a pore-sieve (*Cydonium*); this should rather be termed cryptostomy than lipostomy. In those two remarkable sponges, *Tribrachium schmidtii* and *Disyringa dissimilis*, the cloaca is produced beyond the sponge-body into a long cloacal or excurrent tube, the walls of which are cribriporal, the pores replacing the oscular opening (Pl. XVII. fig. 1; Pl. XLI. figs. 1, 5).

Secondary Canals or Epochetose System.[1]

Folding is not confined to the choanosomal plate or spongophare, but frequently affects the entire sponge, producing secondary cavities or canals (*epochets*). The simplest case of an excurrent epochet—or exochet,—as we may term it for brevity, is produced by an incurving growth of a fan-shaped plate till the lateral edges meet and unite, a vasiform

[1] ὀχετός, ὁ, a channel.

sponge resulting (*Pacillastra schulzii*), the included cavity of which has been called a "pseudogaster," and the mouth a "pseudostome." It is conceivable that the margins of such a vase may incurve till a hollow sac-like form results, but nothing parallel to this occurs in the Tetractinellida.

It is possible that the cloaca of some sponges may result from an invagination of the ectosome, in which case the cloaca would be a pseudogaster, and its apparent oscule a pseudostome; it is just possible that the cloacas of *Cinachyra barbata* and of *Chrotella macellata* may be of this nature.

When the sponge presents an incurrent as distinguished from an excurrent surface, as is the case in most if not all plate-like sponges, the incurrent surface may be invaginated, or the sponge may be folded, so that the incurrent face forms the inner surface of the folds; in such a case an incurrent epochet or esochet,—the "vestibule" of von Lendenfeld —results. Such vestibules occur in *Cinachyra barbata*, though they appear to result rather from an invagination of the cribriporal roofs which overlie the incurrent canals than from an invagination of the actual cortex. These vestibules do not differ in any structural particular from the cloacas of the same sponge, and this leads me to imagine that the cloacas of this sponge and of *Chrotella macellata* may be truly exochets, since they result from the invagination of the cribriporal roof of excurrent canals.

In many Geodine sponges long irregular canals result from an infolding or ingrowth of the incurrent surface, but these vestibules are not always poriferous, frequently they are lined by the chitinous tube of some infesting Annelid, which may, indeed, have provoked their formation. As is well known, the worms inhabiting the epochets in the horse sponge, *Hippospongia equalis*, were mistaken by Peysonnel for the essential animal of the sponge.

In the gigantic Geodine sponge, *Cydonium neptuni*, the sponge-wall acquires considerable thickness through the rich development of both exochets and esochets, which, however, cannot serve as canals, since most of them are filled with a dense accumulation of spicules, extruded into them by the sponge.

Histology.

In the Tetractinellida the ectoderm always occurs as an epithelium consisting of pavement-cells (pinacocytes). It invests the exterior of the sponge and lines the intercortical cavities and incurrent canals.

The endoderm except where it lines the flagellated chambers is also an epithelium, which differs in no perceptible respect from that of the ectoderm.

The greatest variety of histological detail is presented by the so-called mesoderm.

A cuticula does not appear to exist, at least I have never found any traces of it, and

my doubtful suggestion of its occurrence in *Pachymatisma johnstonia* has not been confirmed.

The epithelium, whether ectodermal or endodermal, scarcely ever retains in spirit specimens the outlines of its component cells, which are solely indicated by small, circular nuclei, surrounded by fine granules, and more or less regularly distributed through a thin superficial membrane, which represents the confluent cell-walls. In rare and exceptional instances, however, the outlines of the cells are preserved, as in a specimen of *Craniella cranium* from Kors Fjord, and in several of the Challenger sponges. Living specimens of *Pachymatisma johnstonia*, treated with gold chloride and formic acid, yield very clearly expressed epithelium, lining the canals of the cortex. Strange to say it is without definite cell-outlines, but the contained protoplasm, however, is very admirably displayed, as a superficially extended film produced into innumerable fine sometimes branching threads (Pl. XXXIV. fig. 22), reminding one altogether of ink splashes. An unstained oval space in the middle represents the nucleus, which in transverse section is seen characteristically bulging out the cell-wall beyond the general surface. The thread-like processes of adjacent cells seldom appear to unite, but terminate abruptly. This structure reminds one of that represented by von Lendenfeld as occurring in *Dendrilla rosea*,[1] but in this sponge the processes of the plasma are longer, broader, and less numerous than in *Pachymatisma johnstonia*. Von Lendenfeld observes that the pinacocytes of the inner epithelium of the skin are somewhat smaller than those of the outer layer, where they measure 0·01 to 0·015 mm. in diameter. In *Pachymatisma johnstonia* a marked difference in size occurs in the pinacocytes of the different intercortical canals, but these canals appear to be all of the same nature. In some the protoplasmic portion measures (including the thread-like processes) 0·02 mm. in diameter, in others as much as 0·036 mm.

No trace of a flagellum or cilium has been observed in connection with the pinacocytes of any Tetractinellid.

Choanocytes.—The collared flagellated cells or choanocytes of the endoderm present in the least highly organised species of the genus *Tetilla*, and in *Placina*, F. E. Schulze, the same characters as have already been made known in the case of other sponges by James Clark, Carter, Haeckel, Schulze, and other investigators. In the remaining Tetractinellida, *i.e.*, the vast majority of the group, a curious modification of this structure occurs. The body of the choanocyte is produced into a long cylindrical or conical process, which is tubular for the greater part of its course, only the basal part being solid, and thus representing the collum; the distal three-quarters appertaining to the collar. Distally the collar curves outwards and becomes concrescent with the similar collars of the surrounding choanocytes. From the concrescence of the collars there results a delicate film or membrane, which forms a second lining to the wall of

[1] *Zeitschr. f. wiss. Zool.*, Bd. xxxviii. pl. xii. fig. 22.

the flagellated chamber (Pl. VIII. fig. 20; Pl. XII. fig. 28). Looked at face on this membrane has the appearance of being fenestrated by regularly distributed round or oval openings, which represent the openings of the tubular collars of the choanocytes (Pl. VIII. fig. 20). Sometimes (Pl. XXXIII. fig. 11) a small cell with a distinct nucleus is present in the lumen of one of these fenestræ; this appears to belong to one of the choanocytes, which has been torn from its attachment to the chamber-wall and pulled by the contraction of the collar to a level with the membrane. The physiological meaning of this structure is not obvious; that it is not an artificial product appears from the constancy with which it is present in certain groups and not in others; I have never seen more than doubtful signs of it in the Monaxonids, it certainly does not occur in the Suberitidæ nor in the Tethyidæ, and it may possibly prove to be characteristic of the Tetractinellida only.

Since the fenestrated membrane stretches across the flagellated chamber transversely there must be an aperture or apertures in it for the passage of water from the prosodus to the aphodus, though I have never succeeded in finding any; it is possible that the apertures have the form of pores no larger than the lumen of the choanocytal collars, and in this case they would be very difficult to distinguish. It is also a curious fact that I have never yet seen the flagella of the concrescent choanocytes, though I have never failed to find them in the case of choanocytes which are not concrescent. It might be explained on the supposition that the flagella are retracted in the former case; but that naturally leads to the inquiry as to why they are not retracted in the latter.

The concrescent choanocytes are always restricted to the prosodal face of the flagellated chamber, extending sometimes quite up to the aphodus, sometimes ceasing halfway across the length of the chamber from it, and since they are always directed with the collars pointing towards the aphodal end of the chamber, the fenestrated membrane is constantly concave towards the aphodus and thus it is easy to distinguish the aphodal from the prosodal pole of the chamber, simply by an inspection of the fenestrated membrane. The collars of those choanocytes which lie nearest the aphodus are always shorter than of those which lie further away, a fact already noticed by von Lendenfeld in *Aplysilla violacea*, Lend.[1] This reduction in length of the choanocytes as they approach the prosodal pole renders the fenestrated membrane more concave than it would otherwise be.

Carter, after having rightly described the structure and mechanism of the flagellated chamber, subsequently represented it as consisting of choanocytes with the flagella turned outwards, *i.e.*, in the light of our present knowledge into the mesoderm. This is made the subject of scoff by Professor Haeckel, who is nothing if not logical, and unquestionably the presence of flagella in such a position would be a little surprising,

[1] *Zeitschr. f. wiss. Zool.*, Bd. xxxviii. p. 260, pl. xi. fig. 13.

yet in several sponges possessing a clear, transparent, collenchymatous mesoderm, particularly in *Thenea* (*Thenea delicata*, Pl. VI. fig. 20), fine filaments may be frequently observed, produced from the base of the choanocytes and extending radially from the chambers into the surrounding matrix. Of course these are not flagella, but with the methods in vogue in Carter's time they might easily be mistaken for them, and erroneous as one must admit Carter's inference to have been, one cannot at the same time refuse a tribute of admiration to his surprising acuteness of observation. Whenever these filaments are observed the tubular collars of the choanocytes will be found to be of unusual shortness, and the flagellated chambers in which they occur of far less than the usual diameter, owing to the unusually close approximation of the choanocytes, the bases of which form an almost continuous wall. The whole appearance is suggestive of a contraction of the choanocytal wall under the influence of some strong stimulus, possibly of the alcohol into which the sponge was plunged on removal from the dredge.

Returning now to the more normal chambers which are not thus contracted, close observation reveals the presence of lateral protoplasmic processes extending radially from the bases of the choanocytes and continuously uniting each of them with its surrounding fellows. These processes stain deeply with hæmatoxylin and are probably contractile. If so the contraction of the flagellated chambers is probably partly brought by their action, partly by a shortening of the collums of the choanocytes drawing their bases towards the fenestrated membrane, which thus furnishes a *point d'appui*. It is no doubt owing to the contraction of the chambers that the centrifugal filaments are rendered visible. They may be traced from the choanocytes into continuity with surrounding collencytes or adjacent pinacocytes, if an epithelial surface happens to lie near enough (Pl. VI. fig. 20).

The Mesoderm. Collenchyma.—The mesoderm in its simplest form consists of gelatinous connective tissue (collenchyma), which was first described accurately and its true nature pointed out by F. E. Schulze. It consists of a clear transparent jelly-like basis which does not stain with reagents, and which is produced by the alteration or excretion of numerous more or less stellate irregularly branching cells (collencytes), which are irregularly distributed throughout it. Although spoken of as gelatinous the base is not gelatine-yielding, it is singularly unalterable under the action of reagents, and would probably repay a careful chemical examination.

The collencytes may be best studied in *Thenea muricata*, since in this sponge the collenchyma attains an abnormally rich development; but almost any collenchymatous sponge serves nearly as well. Careful observation proves that they always pass into each other by the confluence of their thread-like processes.

Sarcenchyme.—By the modification of collenchyma in various directions numerous other tissues are produced; one of the most important of these is sarcenchyma. Schulze has already pointed out that in sponges with collenchymatous mesoderm, such as

Euspongia, this tissue in some species suffers a marked change in the neighbourhood of the flagellated chambers, granules appear in it, and are sometimes so richly developed as to obscure the collencytes. This modification Schulze distinguishes as granular collenchyma. From it to the sarcenchyma characteristic of sponges with aphodal chambers is but a short step. The granules of the granular collenchyma then evidently form a part of the collencytes, which have lost their stellate branching form and become polygonal by apposition. The gelatinous base of the original collenchyma is now reduced to a minimum, and the granular cells, now termed sarcencytes, lie so close together that usually no line of demarcation is visible. Occasionally, however, a narrow clear inter-space can be discerned, and the composition of the sarcenchyma as a congeries of sarcencytes is thus made clear. The collenchymatous base probably persists, and we may regard it as a continuous medium in which all the cells composing the sponge are more or less immersed.

Cystenchyme.—In some sponges, *Pachymatisma* and many others, including many Lithistids (Pl. XXVII. fig. 14; Pl. XXXIV. fig. 12), the collenchyma undergoes a modification of another kind, and this chiefly in the ectosome or its neighbourhood. The collencytes are replaced by or transformed into oval vesicular cells, with a thin but definite cell-wall, enclosing a small quantity of pale not deeply staining protoplasm, which lines the cell-wall as a thin layer, and extends in narrow threads to the protoplasm in which the excentrically situated nucleus is immersed. The rest of the cell is vacuolar. These vacuolar or vesiculate cells may lie in a collenchymatous matrix isolated from each other, or they may be so numerous and closely approximated that all trace of intervening collenchyma disappears. This vesicular connective tissue (cystenchyme), as has been already remarked by several investigators, naturally recalls the similar tissue in Mollusks and other Invertebrates. From a similar tissue may arise that which for want of a better name I have called cavernous collenchyme: good examples of this occur in the Tetillidæ, *e.g.*, in *Tetilla gracilis* (Pl. V. fig. 5). In this tissue the cell-walls of the vacuolate cells, which are accumulated in nests, appear to have broken down or fused together, and numerous large cavities result, each when first formed containing the protoplasmic remains of several cystencytes, but subsequently these appear to become absorbed and the cavities are left empty.

Chondrenchyme.—In yet other cases the gelatinous basis of the original collenchyma acquires additional consistency, and some of the collencytes are replaced by round or oval granular cells, a tissue resulting, which bears a remarkable resemblance to hyaline cartilage (*Thrombus challengeri*, Pl. VIII. figs. 35–37). Apparently no experiments have been made with a view to ascertaining whether this is chondrin-yielding or not.

Thesocytes.—No tissue that can be called thesenchyme has yet been observed in any sponge, but in many cases, notably in *Thenea*, more or fewer of the collencytes are modified to form what may fairly be regarded as reserve cells or thesocytes. In an

ordinary collencyte smooth, shining, clear, colourless globules or granules make their appearance; they take a deep stain with hæmatoxylin and other tinctures, and are probably of an albuminoid nature; at all events they can be shown to be neither starch, fat, inulin, tunicin, cellulose, nor sugar. In *Thenea muricata* I have given the following account of them:—"In an irregularly defined layer, a little below the investing epithelium of the sponge, at or about the level of the first or second ranks of the tangential canals, the collencytes have undergone a remarkable internal change (Pl. XVII. fig. 18): within the granular protoplasm a smooth shining globule makes its appearance, it is colourless, transparent, homogeneous, and highly refringent. In some corpuscles only one such body is present, in others several, lying in close contact with flattened opposed faces. The numbers in the several groups are not in any regular progression, nor are the granules of a group all of the same size: there may be one large and several small ones. Sometimes they lie in immediate contact with the protoplasm of the collencyte, more often separated from it, lying in a vacuolated space. We are able fortunately to determine the stage in which they earliest appear by finding them in evidently very young corpuscles [collencytes] distinguished by the presence of a comparatively large quantity of finely granular and deeply staining protoplasm. From this starting point we can readily trace their history as they are followed deeper into the interior of the sponge. In corpuscles a stage older than the preceding we find the protoplasm becoming less granular, staining much less deeply with carmine, and diminished in quantity, so that it forms a more spherical or oval shell around the granules, but still retains its outwardly radiating processes: these, however, in the next stage disappear, and the [choanocyte] becomes a mere oval or spherical sac filled with the products of its own secretion. The shining granules next begin to diminish in number and size, and finally disappear."[1]

Chromatocytes or Pigment-Cells.—Various kinds of pigment-cells are met with in the Choristida; sometimes they present themselves as collencytes crowded with pigment-granules, like those represented by Schulze in *Euspongia officinalis*.[2] This is the case in *Pachymatisma johnstonia*, pigmented collencytes occurring plentifully scattered throughout the cortex. Sometimes they occur as minute clusters of pigment-granules, without any evident associated protoplasm (*Craniella similima*, p. 33); more usually they form rounded or oval cells with definite cell-walls, and scarcely any other contents than pigment-granules, which are usually spherical, and of much larger dimensions than those of pigmented collencytes (*Stryphnus niger*, p. 172, Pl. XIX. figs. 11, 20). The chromatocytes of *Stryphnus* are of unusually large size, frequently they are much smaller, as in *Tetilla marginalis* (p. 15). Occasionally by repeated multiplication they form cellular aggregates, or chromatochyme; round or oval masses of such tissue occur in the cortex of *Craniella carteri* (p. 36, Pl. I. figs. 34, 35).

[1] *Thenea muricata, Ann. and Mag. Nat. Hist.*, ser. 5, vol. ix. p. 447, pl. xvii., 1881.
[2] *Zeitschr. f. wiss. Zool.*, Bd. xxxii. pl. xxxv. fig. 7.

Granular cells somewhat resembling the chromatocytes of *Craniella carteri*, and occurring both in isolation and in rounded aggregates, are characteristic of most species of *Pilochrota* (p. 125, Pl. XX. figs. 9, 11, 13; p. 130, Pl. XIV. fig. 15; p. 132, Pl. XIV. fig. 37; p. 133, Pl. XIV. fig. 21; p. 122, Pl. XXXIX. figs. 24–26). The function of these cells is unknown, but they have much the appearance of being pigment-cells without pigment. In *Pilochrota gigas* they occur in the fibrous processes by which the sponge attaches itself to foreign bodies, frequently running in rows between the fusiform cells of the fibrous tissue, and then reminding one of the appearance of fat-cells in some longitudinal sections of muscle in the higher animals. Granule-cells of unknown function also occur in *Pœcillastra schulzii* (p. 81, Pl. IX. fig. 29).

In many species of *Myriastra* and *Anthastra* oval clusters resembling pigment-cells occur, but are really as I imagine groups of some Bacterial organism (*vide* Pl. XII. fig. 25).

Inocytes.—Fusiform connective-tissue cells or inocytes were first described as muscle-cells in my account of *Dragmastra* (*Stelletta*) *normani*,[1] but discovering that this was an error I pointed out their true nature in a succeeding paper on *Geodia barretti*.

They may be most readily studied in fresh specimens of *Tethya lyncurium* (in which they form the densely fibrous inner half of the cortex), by treatment with gold chloride and formic acid, subsequent dissociation in 30 per cent. alcohol, and staining with borax carmine.

When teased out they present themselves, as described in my account of *Dragmastra normani*, as long, fusiform cells, consisting of a clear, transparent, outer wall, which does not stain with reagents and readily splits on teasing into fibrillæ, and a long axial thread which is fusiform, homogeneous, faintly bluish in colour, and highly refringent. Acetic acid renders the axial thread somewhat more distinct, nitric acid acts in the same way, but more vigorously; caustic potash in a 5 per cent. solution causes the cell to swell up and renders the axial thread invisible; strong nitric acid applied to the fibrous tissue destroys the outlines of the individual cells, producing an apparently homogeneous matrix, in which the axial threads remain sharply defined; on adding magenta the latter stain deeply, but not the matrix.

The axial thread bears much the same relations to the hyaline sheath that a collencyte does to the surrounding gelatinous matrix; and though apparently structureless in *Stelletta normani*, in *Tethya lyncurium* it always presents a finely granular character, and encloses in the middle a small oval nucleus, with the long axis lying in the same direction as that of the thread; within the nucleus is a small spherical nucleolus.

The inocytes are arranged with overlapping ends in parallel rows forming fibrous strands, these run parallel along the sides of the spicular fibres, along the course of the

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. v. p. 136.

main water-canals and parallel to the surface in the cortex. Transverse strands also extend through the cortex, the most marked being those which accompany the radiating spicular fibres. Owing to their generally tangential direction in the cortex a transverse section presents the appearance shown in Pl. XVI. fig. 13, *i.e.*, tracts of fibres are seen cut across transversely, surrounded by others cut longitudinally. In the transverse sections the hyaline wall appears as a round or oval area, enclosing a circular, granular spot in the centre, which represents the axial fibre cut across. Collencytes are almost always associated with the inocytes of the fibrous strands, and sometimes granular- or pigment-cells as well. In many sponges (*Pilochrota gigas, Psammastra murrayi, Tethya lyncurium*, and many others) strong bands are given off from the cortex, sometimes as much as 20 mm. in length, for attachment to stones, shells, or other foreign objects. These (Pl. XX. figs. 9–13) chiefly consist of longitudinal strands of inocytes or myocytes.

Myocytes.—These are long, granular, fusiform cells, enclosing a small oval nucleus with a spherical nucleolus in the middle. A thin layer of hyaline material is frequently present around them, or they may occur simply immersed in a homogeneous, gelatinous matrix. They differ from inocytes chiefly in the reduction or suppression of the hyaline sheath of the latter, and in the constantly granular character of the axial thread, which in the myocyte forms the chief part of the cell. Collencytes are associated with the myocytes and can sometimes be traced into continuity with them (Pl. XXXIX. fig. 10); either the filamentous end of the protoplasmic portion of the myocyte, or small fibrils extending from its sides in the neighbourhood of the nucleus, passing into the processes of a branching collencyte.

The myocytes chiefly occur concentrically arranged about the openings of the water-canals; thus they are always present about the central aperture of the vela and form a thick sphincter representing an enlarged and highly muscular velum about the ends of the chones. Radiately arranged myocytes usually are associated with concentric ones in a velum, crossing the latter transversely. In the case of a typical chone the inner end lies in the inner (inocytal) layer of the cortex, and the sphincter is evidently only a modified portion of this layer, into which it gradually passes. The myocytal ring or muscular sphincter is, however, always easily distinguished, even when examined in unstained preparations and under a low magnification. This is due to the extreme thinness of the hyaline sheath about the axial protoplasm, so that the protoplasmic bodies of the myocytes lie almost in contact with each other, and thus produce a darkly granular ring of tissue, which is in marked contrast with the clearness of the inocytal layer, in which the protoplasmic threads are separated by the thickness of two comparatively thick hyaline walls. The radiating myocytes of a velum are frequently attached at one end to the epithelium lining the margin of the central aperture; in such a case the point of attachment may frequently be observed sunk below the general

outline of the margin, as though by the pull of the myocyte upon it (Pl. XV. fig. 17). In *Cydonium magellani* (Pl. XXI. fig. 13) a transverse section of a chonal sphincter presents appearances suggestive of the existence of a fibrillated sheath surrounding each axial portion of the myocytes, and as in this case the fibrillæ stain with hæmatoxylin, they would appear to be of a different nature to those of the inocytes.

Æsthocytes.

Stewart, Bell's Comparative Anatomy and Physiology, p. 431, 1885.

Lendenfeld, Das Nerven-system der Spongien, Zool. Anzeiger, Bd. viii. pp. 47–50, pp. 448, 466, 488.

„ Beiträge z. Kenntniss des Nerven- und Muskel-systems der Hornschwamme, Sitzungsb. d. k. Akad. d. Wiss. Berlin, p. 1015, 1885.

„ The Histology and Nervous System of Calcareous Sponges, Proc. Linn. Soc. New South Wales, vol. ix. p. 982.

„ Synocils, Sinnesorgane der Spongien, Zool. Anzeiger, Bd. x. p. 142, figs. 1–3, 1887.

Vosmaer, Biologisches Centralblatt, Bd. vi. p. 199, 1886.

In the summer of 1883 I visited the laboratory of Professor Lacaze Duthiers at Roscoff with the express purpose of seeking for sense-cells in *Pachymatisma johnstonia*, a histological examination of the chonal sphincters having convinced me that they might be expected to exist in that sponge. A fine specimen of the species was obtained for me from the Island of Douon, and the slow closure of the sphincters when irritated by the touch of a style was repeatedly observed. This phenomenon has been more than once described by other investigators in the case of other sponges. The specimen was then treated for subsequent histological examination by various methods, and sections were cut on my return to England. The results however were not conclusive enough for publication. Fusiform cells were certainly observed at the outer margin of the chones and traced inwards towards certain ill-defined cells, which I can compare to nothing better than ink-blotches smeared round the margin.

In the Challenger collection several sponges present fusiform cells in positions and with characters corresponding to those which Lendenfeld regards as æsthocytes. In *Cinachyra barbata*, one of the Tetillidæ, they occur in restricted regions on opposite sides of the entrance to the cloacas or vestibules, which as already mentioned are precisely similar to each other in structure. They will be found described on page 27 (Pl. XXXIX. figs. 6–8). In *Pilochrota pachydermata*, one of the Stellettidæ, a sponge provided with a very thick almost entirely fibrous cortex, similar cells occur generally distributed beneath the epithelium of the oscular wall. They will be found described on page 123 (Pl. XXXVIII. fig. 27). Finally, in *Anthastra parvispicula* fusiform cells have been observed directed inwards at right angles to the epithelium lining a chone immediately below the margin of the pores (Pl. XL. fig. 2).

Certainly the position, arrangement, and characters of these cells are very suggestive, but further observations appear to be necessary before their sensitive function can be definitely admitted.

Protoplasmic Continuity.

Whether the cells just alluded to should prove to be æsthocytes or not, there remains every reason for believing that the collencytes play the part of a rudimentary or undifferentiated nervous system, *i.e.*, they serve as intermediaries placing the various

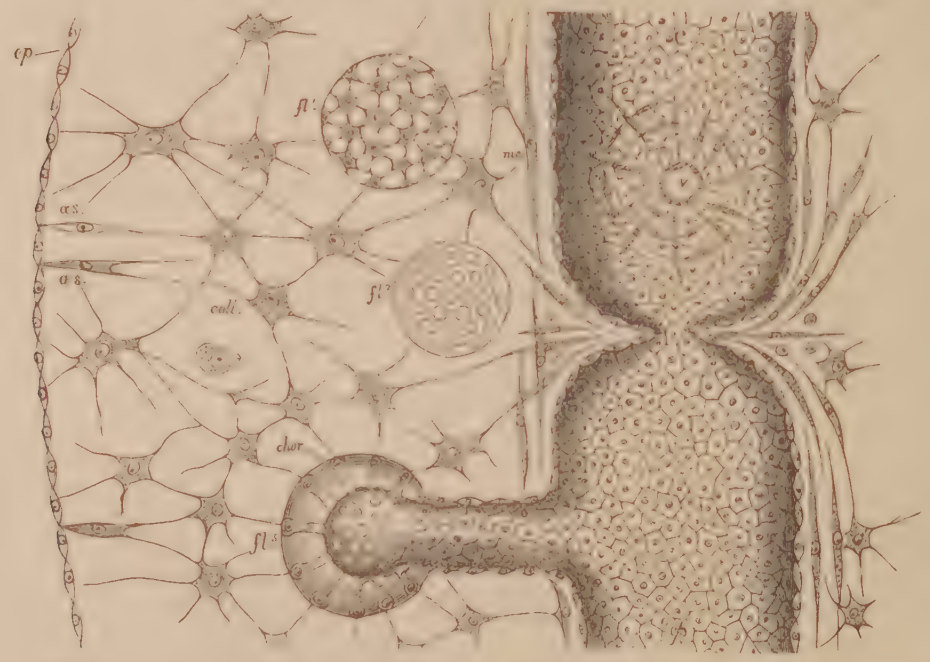


FIG. IX.—Diagram to represent the protoplasmic continuity of a sponge. *ep.*, epithelium; *æs.*, æsthocytes; *coll.*, collencytes; *mc.*, myocytes; $fl_{1\text{-}3}$, flagellated chambers; fl_1., seen from the prosodal face; fl_2., from the aphodal; fl_3., in median longitudinal section; *v.*, velum, seen *en face;* a transverse section is seen in the middle of the same canal as that in which this occurs.

histological elements of the sponge in protoplasmic continuity. When describing *Thenea muricata*,[1] I was already much impressed with this view and wrote as follows:—"The ends of the fibres or of the branches from them (*i.e.*, of the collencytes) appear to be ultimately brought into close connection with the ectodermal and endodermal layers, for on the inner faces of these layers fine filamentous processes are often seen wandering, and the branching processes of the connective-tissue corpuscles (collencytes) can frequently be traced right up to them; in several cases also I believe I have seen a connection between the individual cells of a flagellated chamber and the branching processes of a corpuscle.

[1] *Ann. and Mag. Nat. Hist.*; ser. 5, vol. ix. p. 446, 1882.

It is indeed difficult while studying this reticulum of connective-tissue corpuscles to resist the idea that we are here dealing with something that plays the part of a nervous system."

In the Challenger sponges I have not yet traced the collencytes into continuity with the ectodermal cells, a fact which makes somewhat for Lendenfeld's theory as to the function of the supposed æsthocytes, but I have repeatedly traced them into connection with each other, with the choanocytes of the flagellated chambers, and with the myocytes, and thus I entertain no doubt as to the general protoplasmic continuity of the cellular elements of the sponge. The continuity of the choanocytes of a flagellated chamber with each other has already been alluded to (p. xxxviii).

Scleroblasts.

Lieberkühn, Müller's Archiv f. Anat. u. Physiol., pts. iv. and v. pl. xv. fig. 22, 1856.
Carter, Ann. and Mag. Nat. Hist., ser. 2, vol. xx. p. 21, pl. i. fig. 8, 1857.
O. Schmidt, Zool. Ergebnisse d. Nordenfahrt, p. 120, pl. i. figs. 19–21, 1872.
Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xiv. p. 13, pl. xxi. figs. 26, 27, 28, 1874.
Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. v. pp. 141, 142, pl. vii. fig. 21; p. 256, pl. xi. fig. 18; p. 401, pl. xvii. figs. 18–22, 1880; vol. ix. p. 159, pl. xviii. figs. 12, 17, 18, 1882.
Polejaeff, Calcarea, Zool. Chall. Exp., pt. xxiv. p. 32, pl. vi. fig. 3, 1884.

Lieberkühn and Carter in their classic studies of *Spongilla* describe the oxeas as originating within a fusiform spicule-cell or scleroblast, appearing at first as immeasurably thin, hair-like rods lying transversely to the length of the cell. O. Schmidt describes the chelæ, sigmas, and orthodragmas of *Esperia* as formed within a spicule-cell (scleroblast), the nucleus of which lies on one side of the orthodragma and in the concavity of the chela or sigma. Carter next described the chelæ of *Esperia ægogrophila*, Johnston, as developing within the embryo in scleroblasts of from 0·0084 to 0·028 mm. in length, and mentions the interesting fact that the chelæ, which are anisochelate in the adult, are isochelate at their first appearance. The sigmas and toxas also originate in scleroblasts, the latter several in one cell, so that at their inception they are dragmas. This is not true of all such spicules, however.

My own paper states that the sterraster of the Geodine sponges originates in a scleroblast, the nucleus of which lies in the hilum of the spicule. The young forms of the sterraster occur only in the choanosome, where they are present in considerable numbers, they are supposed to travel thence into the cortex, where they form a dense spicular layer. In this layer none but fully grown spicules are found. I have also shown that the large oxeas of *Tetilla*, *Stelletta*, and *Geodia* are formed each within a single scleroblast, which persists at least up to the time that the spicule has attained its full growth.

Polejaeff represents the remains of a scleroblast enveloping a large oxea in a calcareous sponge. The examination of the Challenger sponges fully confirms previously obtained results, and extends them.

In the Choristida all the spicules, both large and small, originate each in a single scleroblast, which persists throughout the life of the spicule. The scleroblast in the case of the large spicules is a large granular cell, extending all round the spicule, which it has formed as a siliceous secretion. In the granular protoplasm, variously situated, is a large oval nucleus containing a large spherical nucleolus (p. 34, Pl. II. fig. 20; Pl. XIII. fig. 10). In the case of small spicules the scleroblast is not distinguishable from an ordinary sarcencyte, and therefore does not present an unusually large nucleus.

In the Lithistida the young calthrops on which the adult tetracladine element or desma is moulded originates in a scleroblast similar to that in which the large spicules of the Choristid sponges are developed (p. 290, Pl. XXX. figs. 20, 21), but with the fully formed desma more than one is probably associated; thus each of the four depressions which occur about the centrum in the angle between the arms of a tetracladine desma appears to be occupied by a scleroblast, and others may possibly be distributed along the sides of the arms, though they have certainly not been observed.

In the rhabdocrepid desmas, *i.e.*, desmas moulded on a monaxon spicule (p. lix), the rhabdus which serves as the foundation is very probably formed within a single scleroblast, but this, although I have searched long and closely for it, I have never seen. The onlayering of silica which converts the rhabdus into the desma is almost certainly secreted by an envelope of surrounding scleroblasts, which are small when compared with the single scleroblasts of the large spicules of the Choristida. Thus in *Corallistes masoni* I have more than once observed small cells associated with the desmas, and separated from the surrounding mesoderm by a vacant interval, and the only serious objection I can discover to regarding them as scleroblasts is that they are not more frequently encountered, but considering the difficulty of preparing thin slices of these and similar sponges without to some extent tearing the tissues and partially displacing the cells, this will not probably be thought a very serious difficulty.

Genital Products.

It is somewhat surprising, considering the searching investigation to which they have been subjected, that more of the Challenger sponges have not yielded some trace of ova or spermatozoa.

Ova have been met with in *Chrotella macellata* (p. 22, Pl. IV. figs. 21, 22), one of the Tetillidæ; and in *Tethya seychellensis* (p. 430, Pl. XLIV. figs. 4–6), a Monaxonid in which they occur in great numbers, constituting at least half the volume of the choanosome.

Spermatozoa have been encountered somewhat more frequently; they occur in the following species amongst others:—*Tetilla pedifera* (p. 7, Pl. XLI. figs. 7, 13–21), *Tetilla grandis* (p. 12), *Chrotella macellata* (p. 22)—the same individual in this sponge containing ova and spermatozoa; *Caminus sphæroconia* (p. 216, Pl. XXVII. figs. 19–21), and *Erylus*

formosus. The sperm clusters in these cases are from about 0·05 to 0·1 mm. in diameter; they lie in cavities lined by endothelium, and are never enclosed in a cover-cell.

No genital products have been observed in any species of the family Stellettidæ, nor in any of the order Lithistida.

The Skeleton.

The Spicules.—The consideration of this subject should logically have followed on the description of the scleroblasts, but as its treatment is of necessity lengthy, it will be more convenient to assign it a chapter to itself.

The spicules of sponges may consist of calcite (Calcispongiæ), opal, or spongin (*Darwinella aurea*). In the Tetractinellida they are always composed of opal; and spongin only occurs in small quantity, uniting as by short synaptactulæ adjacent spicules together. The composition of spongin requires renewed chemical investigation, it is most nearly allied to silk but differs from it in yielding leucine and glycocine, instead of leucine and tyrosine, when treated with sulphuric acid.[1]

The mineral matter of siliceous spicules is colloidal silica,[2] having a specific gravity of 2·0361 (Thoulet),[3] or 2·04,[4] its refractive index is 1·449, or almost identical with that of solid colloidal silica allowed to harden by spontaneous evaporation. As to its precise composition, somewhat different results have been obtained by different experimenters, thus Thoulet found 86·82 per cent. of silica and 13·18 per cent. of water, from which the formula $(SiO_2)_2OH_2$ may be deduced; Schulze, however, gives as the results of experiments made for him only 7·16 per cent. of water, and this more nearly corresponds to the formula $(SiO_2)_4OH_2$, the exact quantity of water required by this formula being 6·977 per cent.

My own determinations were made with special precautions to ensure the purity of the spicular material employed. The spicules were boiled out with fuming nitric acid, washed and dried; they were then freed, if necessary, from foreign particles, such as grains of sand, by separating with Thoulet's fluid; after washing and drying, they were then ground to an impalpable powder in an agate mortar, and again boiled in fuming nitric acid to destroy all traces of the axial organic fibre, which may escape the action of the acid when the spicule is boiled whole. After well washing, the powder was dried in a water oven at 98°; from 0·25 to 0·35 gramme was transferred to a platinum crucible and heated at first gently by means of a Bunsen over asbestos-board, and finally as intensely as possible by means of a Herapath for five to ten minutes. It was found that at the low temperature, below red heat, attainable over asbestos, about two-thirds of the contained water was expelled, and the powdered material, at first snow-white, acquired a faint but distinct yellowish-brown tint, like that of charred paper. Since all free organic matter had been previously destroyed, it is clear that a small quantity must

[1] Städeler, *Ann. Ch. Pharm.*, vol. cxi. p. 12.
[2] Sollas, *Quart. Journ. Geol. Soc.*, vol. xxxiii. p. 254, 1877.
[3] Thoulet, *Comptus rendus*, t. xcviii. p. 1000, 1883.
[4] Sollas, *Sci. Proc. Roy. Dubl. Soc.*, vol. iv., N. S., p. 374, 1886.

exist in chemical union with the silica of the spicular opal. On heating with the Herapath the brown tint disappears, and the ignited silica is snow-white.

The total amount of water found in the different species experimented upon is given in percentages below :—

Choristida :—

Pachymatisma johnstonia, . 7·16

Anthastra communis, . . 6·6 (probably too low, the spicules were not freed from any foreign particles which might have been present).

Lithistida :—

Theonella swinhoei, . .	6·53	*Corallistes masoni*, . . .	6·23
Vetulina stalactites, . .	6·27	*Siphonidium ramosum*, . .	6·1

Monaxonida :—

Suberites suberea, . . 7·34

It will be seen that these results, which are not very different from those of Schulze, vary from 0·363 per cent. above, to 0·577 per cent. below that which is required for the formula $(SiO_2)_4OH_2$, the lowest result indeed better accords with the formula $(SiO_2)_5OH_2$, differing from what would be required for it by being 0·1 per cent. too high. The differences appear to be too great to be explained as errors of experiment, and for the present we may abandon the attempt to represent the composition of the spicular silica by any simple formula. It should be observed that the spicules experimented upon had been for several years in alcohol, and it would be worth while to ascertain whether in more recently obtained specimens, like those experimented upon by Thoulet, a larger proportion of water might not be present. As might naturally be expected, the spicules are extremely susceptible to the action of caustic potash, which attacks them even in the cold; thus the large oxeas of *Tethya lynceurium* left to stand for a night in a strong cold solution of caustic potash split up at their ends in a longitudinal direction (Pl. XLIV. fig. 16); the resulting fibres curl outwards away from each other as though under the influence of tension, which must be greater in the outer than the inner layers of spicules. When boiled for some hours in a strong solution of caustic potash, the Lithistid desmas undergo a curious change, so that they no longer decrepitate when strongly heated, but quietly lose their transparency and become white and opaque; with further boiling all the silica is removed, and a delicate transparent film remains behind which stains with magenta but dissolves with effervescence in hydrochloric acid, leaving only the slightest trace of residual matter.[1] Treated with hydrofluoric acid, the spicules of course readily dissolve; the effects of solution are most evident at the extremities of the spicules.

[1] Sollas, *Proc. Roy. Irish Acad.*, ser. 2, vol. iv. p. 490, 1885.

supposing these to be oxeas; a funnel-shaped cavity soon appears, its apex being directed towards the centre of the spicule, within this the axial rod is freely exposed (Pl. XLIII. fig. 18), and the increasing length of the liberated portion of the axial rod enables one readily to judge of the progress of the solution. Although at first sight the acid appears to remove all the substance of the spicule except the axial rod, careful observation will show that this is not the case, for a delicate film of organic matter also remains behind: it has the form of a hollow sheath, corresponding in form and position with the outermost boundary of the original spicule; between it and the axial rod the whole of the spicule is completely removed. The spicule thus consists of a central organic axis, surrounded by concentric layers of opal, the outermost of which is invested in a spicule sheath of organic matter or rather of organic matter in intimate association (chemical union?) with silica. I long ago discovered this sheath by finding it as an insoluble residue after boiling some of the spicules of *Plocamia plena*, Sollas, in caustic potash, but did not then recognise it by this name.[1]

In making observations on the behaviour of spicules under the action of hydrofluoric acid, one has to provide first for the safety of the object-glass of the microscope and next to ensure the transparency of the preparation, for unless precautions are taken it will become obscured by the products of the action of the acid on the glass of the slide and the cover slip; the glass slide is therefore protected by coating it with a film of Canada balsam, which is hardened by drying in the water-oven; one side of the cover-slip is protected in the same way. The spicules isolated by treatment with nitric acid in the usual way are then placed along with a drop of water on the slide, and a drop of acid added, a ring of moderately fluid balsam is then run round the acid, the cover slip laid on—balsam face downwards and plenty of balsam run round the edge; in this way the spicules may be examined with safety under a Zeiss objective "D."

In all but the minutest microscleres, which are structureless and homogeneous, the spicule presents the structure just described, *i.e.*, a central organic axis, which is concentrically surrounded by successive layers of silica of very uniform thickness; the latter are excessively numerous and consequently of extreme thinness, they are readily distinguished by transmitted light and when viewed by oblique light at certain angles give rise to interference colours, which render them iridescent. In all true spicules the axial rod of organic matter extends close to the termination of the spicule, and in some cases can be traced extending a little beyond it. In the Lithistid desmas, however, the axis is continued comparatively only a short distance into the desma, and the mass of the structure consists of concentric layers of silica only; a difference can be discerned however between the axial and the peripheral portion of the more or less rod-like portion of the desma, a difference not altogether dissimilar to that which exists between the central and peripheral parts of the horny fibres of the Ceratosa; thus the central part is faintly

[1] Sollas, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. iv. p. 51, fig. 3, 1879.

granular and crossed by transverse curves convex towards the extremity, these markings are due to the alternation of layers, some more and some less granular, and they correspond to layers of growth as it occurred at the end of the sclere; the peripheral layers are not granular and resemble those of ordinary spicules appearing in optical section as parallel longitudinal straight lines. A simple explanation of this structure is easily found. The growth of the spicule is chiefly in the direction of its length and is not uniform; intervals of slower alternating with others of more rapid progress. During rapid growth the silica deposited is porous and consequently granular in appearance, during the intervals of slower growth it is solid and homogeneous; it is indeed possible that the layers of transparent silica indicate a temporary cessation of growth so far as this consists simply in increase of size, and that the pores of the already deposited silica become filled up during this interval, the filling up proceeding from the surface inwards and never penetrating to any great depth; however this may be, and it is a detail of no real importance, the result in either case is to surround the granular silica with an envelope of transparent silica. But it follows from the fact that the longitudinal growth is so much in excess of the transverse that the intervals between the transparent layers will be much less at the sides than at the ends of the sclere, and thus more general transparency in this region will result.

FORMS OF SPICULES.—NOMENCLATURE.

The terminology in use for designating the different forms of sponge spicules, and we might add of other spicules also, is in a state of far from admirable confusion. The notorious nomenclature of Bowerbank, now brought by necessary curtailments, alterations, and additions into a patched and tatterdemalion state, has been endured by English spongologists for a period which is both long and long enough. On the Continent it seems never to have obtained any general recognition; a fact which its interminable clumsiness readily explains. The two most commonly occurring terms "acerate" (Latin, *acer*, *acris*, sharp, sour, or *acus*, *aceris*, chaff?) and "acuate" (Latin, *acutus*, sharp?) so much resemble each other in manuscript that this alone, independently of their Latinity, would constitute a good reason for their rejection. At first I thought that the inevitable confusion attaching to the displacement of old terms might furnish a sufficient excuse for retaining them unchanged, but subsequently a valuable communication from Dr. Vosmaer, proposing an international scheme of nomenclature, and the deep and general distaste for the Bowerbankian names entertained by my colleagues, led me to take example by Schulze, who has devised an entirely new system of terms for the spicules of the Hexactinellida. I therefore took advantage of the simultaneous presence in London of three distinguished spongologists (Messrs. Ridley and Dendy, and Dr. v. Lendenfeld, then just returned from the scene of his brilliant investigations in Australia), to consult with

them as to the adoption of a new system of terms. As a result we drew up, with the assistance of Professor Stewart of the Royal College of Surgeons, the following scheme, which, as regards the larger spicules, is chiefly founded on the distinction between axes and actines, which I believe I was the first to draw attention to in a paper describing *Tricentrion muricata* (*Plectronella papillosa*).[1] For the general plan of the scheme I am therefore responsible, but several excellent terms proposed by Vosmaer find a place in it.

Dr. v. Lendenfeld was anxious, and I think rightly so, to make as little change as possible in adapting our terms from the Greek, so that they might be used with the same universality as say those of human anatomy; we were thus led to avoid the addition of useless terminations such as "ites" to words complete enough without them, at the same time we felt at liberty to modify the termination for English use so long as this could be done without affecting the root; in other languages other terminations more in consonance with their own genius may be substituted for ours without impairing their intelligibility. Thus it makes little difference whether we say "strongyla" or "strongyle," but the latter has a more English sound.[2] An abbreviation from "actine" to "acte" as used by Schulze is, however, scarcely admissible, since this not only affects the form of the root, but introduces another of a totally different meaning, "acte" in Greek signifying a sea-shore.

Since Greek lends itself more readily to the construction of compound words we have made use of it in preference to Latin. Further, we have not confined ourselves to finding names for the different forms of entire spicules, but have sought also for terms to designate their several parts or regions, feeling convinced that for scientific purposes a replacement of "vulgar" by classical terms is by no means to be deprecated, but rather encouraged, and that earnestly; for not only are brevity and exactness thus ensured, but the classical tongues being still in a sense common to all nations, all writers alike can make use of terms derived from them, and thus since Latin has ceased to be the universal language we may hope to mitigate the confusion of tongues by the multiplication of universally accepted technical terms. It is a comparatively easy task to read a memoir in a foreign tongue when once one is familiar with all the most important and most frequently occurring words, as one must be if a common nomenclature is used to designate the objects and parts of objects which are the subjects of description. In a word, by the extension of a common scientific phraseology, we may hope to reduce the differences between existing languages to a difference in their framework, which may be filled up with terms having a common signification.

Partly for this reason I have not scrupled to invent a new term whenever the nature of the subject seemed to require it; a further justification is to be found in the increased

[1] Sollas, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. iii. p. 236, fig. 3, 1879.

[2] Thus, as we say spicule and spicules in English, and not spiculum and spicula, so I shall speak of oscule and oscules, of conule and conules, and so forth; if it be remarked that to be consistent I ought also to write collenchyme and not collenchyma, I admit it, and at the same time confess that it is only by accident that the latter form found its way into the text.

directness of expression which is gained by the use of a new word when it sums up in itself a whole phrase. This perhaps may explain the fact that those who chiefly cavil at new terms are our ancient friends the phrasemongers.

The distinction between essential and auxiliary skeletal spicules (Bowerbank), or skeletal and flesh spicules (Carter), is of great convenience, and we shall adopt it here, terming the skeletal spicules megascleres, and the flesh spicules microscleres; it is easy, however, to fall into the mistake of regarding this distinction as absolute, while truly it is a mere matter of relative size; the microscleres and megascleres pass into each other by easy gradations, so that it is not possible to say where one ends and the other begins, indeed there would be a certain convenience in accepting a third division of intermediate or middle-sized spicules, which we might call mesosceleres; thus in *Pœcillastra* (*Normania*), there are found megascleres which form the chief framework of the sponge, microscleres which are strewn through it separately, seldom near enough to be in actual contact, and finally mesosceleres which lie close together, forming a dense felt; if these last-named spicules occurred alone as similar spicules do in *Halichondria panicea*, they would almost certainly be classed as megascleres, indeed Carter, in describing similar cases, does not hesitate to call them skeletal, but in *Pœcillastra* and similar cases they would be classed as flesh spicules, and in the descriptive part of this Report they will be found under the head of microscleres. Although the use of the term mesosclere has thus much to recommend it, I have not yet adopted it, since it was not discussed at our conference in London, and it is just one of those points which require discussion by the workers in different groups; it is to be hoped, however, that a general conference of spongologists may be held at some future date, when the whole subject of spicule nomenclature may be fully considered, and a universal system adopted.

In describing the various forms of spicules we shall commence with the megascleres:—

Class I. Megascleres (Megasclera, σκληρός, ά, όν, hard).

Comparatively large or "skeletal" spicules.

The megascleres are divided into the following groups, according to the number and distribution of their axes.

Group 1. Monaxons (Monaxona).

Megascleres of a rod-like form, in which growth is directed from a single origin in one or both directions along a single axis. The ray or rays of a monaxon are known as an *actine* or actines.

The axis of the monaxon as of other megascleres is not necessarily straight, it may be curved or undulating.

Group 2. Tetraxons (Tetraxona).

Megascleres in which growth is directed from an origin in one direction only, along four axes arranged as normals to the faces of a regular tetrahedron.

Forms which are geometrically triaxons, *i.e.*, produced by growth from an origin in one direction along three axes lying in one plane, are regarded as reduced tetraxons.

Group 3. Triaxons (Triaxona).

Megascleres in which growth is directed from an origin in both directions along three rectangular axes.

The growth may take place in both directions along each axis, or in one direction only, or along one or more of the axes in one direction and along the remainder in both directions. One or more axes may be suppressed.

Group 4. Polyaxons (Polyaxona).

Megascleres in which radiate growth from a centre proceeds in several directions.

Group 5. Spheres (Sphæræ).

Megascleres in which growth is concentric about the origin.

Group 1. Classification of The Monaxons.

I. Diactine (*diactina*).—A monaxon in which growth proceeds in both directions along the axis. For this the term rhabdus is substituted as a convenient abbreviation.

II. Monactine (*monactina*).—A monaxon in which growth proceeds in one direction only along the axis. For this form the term style (*stylus*) proposed by Vosmaer is substituted.

Modifications of the Rhabdus.

When the rhabdus is arranged within the sponge so that one end is directed centrifugally and the other centripetally, the centrifugal actine is distinguished as the ecactine and the centripetal as the esactine. Both actines may be of similar shape and size, the rhabdus is then isoactinate, or one may be larger than the other, and the rhabdus is anisoactinate. It is seldom possible to discover the position of the origin of the spicule exactly, but the distinction between iso- and aniso-actinate forms is not made unless the difference is obvious.

The modifications in the form of the rhabdus most useful for classificatory purposes are those which affect its termination. We therefore distinguish the different forms of this spicule by the character of its ends, as follows:—

(*a*) Forms of rhabdus with similar terminations.—

1. *Oxea* (ὀξύς, εῖα, sharp, pointed) (Fig. X., *a*). When the rhabdus is sharply pointed at each end it is a *rhabdus amphioxea*;[1] in nearly all cases in which a spicule is similarly terminated at both ends we shall dispense with the prefix "amphi-" leaving it to be understood, and since the *rhabdus oxea* is one of the most commonly occurring

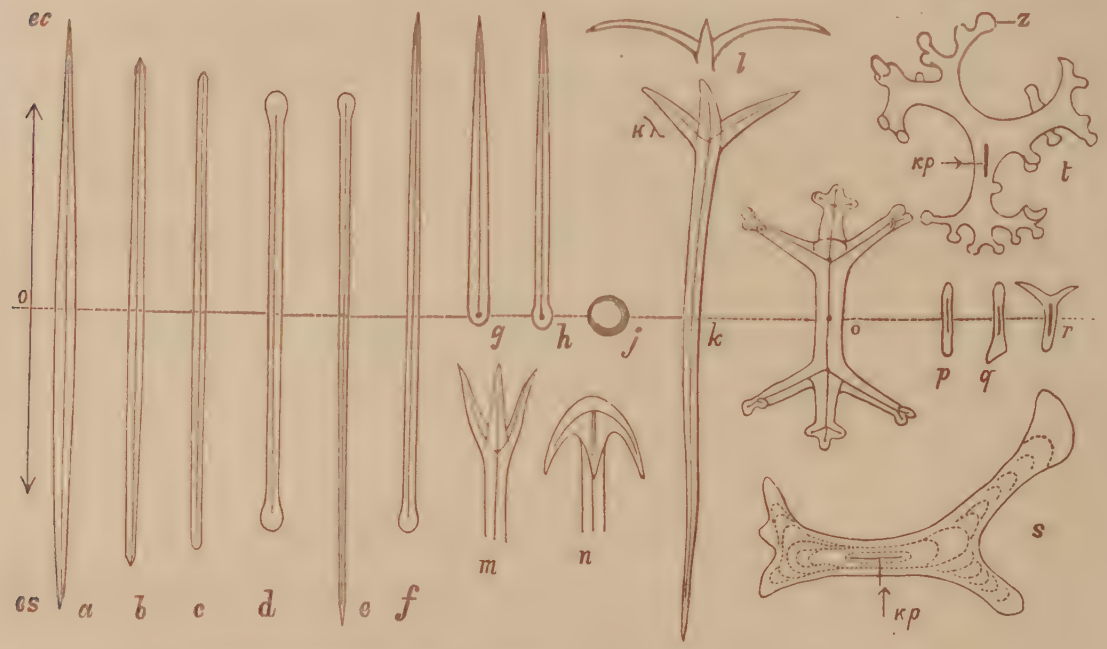


FIG. X.—Modifications of the Rhabdus. *a*, Oxea; *b*, tornote; *c*, strongyle; *d*, tylote; *e*, oxytylote; *f*, tylotoxea; *g*, style; *h*, tylostyle; *j*, sphere; *k*, plagiotriæne; *l*, orthotriæne; *m*, protriæne; n, anatriæne; *o*, amphitriæne; *p*, crepidial rhabdus or rhabdocrepis of a Lithistid desma; *q*, the same, more advanced in growth; *r*, ditto; *s*, ditto, more enlarged; *t*, the fully developed desma. The dotted line marked *o* on the left of the diagram passes through the origin of the spicules; the arrows directed from it indicate the direction of growth of the actines, *ec*, ecactine, *es*, esactine; in fig. *k* the cladome is indicated by the letters κλ; in figs. *s* and *t* the crepis by κρ, and in fig. *t*, *z* indicates a syzygial tubercle.

spicules we shall omit the substantive "rhabdus" and use the adjective "oxea" in a substantive sense. When the actines of other spicules than rhabduses are sharply pointed we shall express the fact by the adjective "oxeate." The term in Bowerbank's nomenclature corresponding to oxea is "acerate."

2. *Tornote* (τόρνος, ὁ, a pair of compasses or turner's chisel. The adjective "*tornotus*" is derived from this) (Fig. X., *b*). When the rhabdus is very abruptly pointed at

[1] The feminine termination is used in agreement with rhabdus.

each end a *rhabdus amphitornota* results, which we shall call a "tornote." The corresponding equivalent used by Bowerbank is "hastately pointed." Although the adjective "tornote" is here used in a substantive sense, it will not be necessary to convert it into "tornotate" when used adjectively, the context will always make sufficiently clear the sense in which it is used.

3. *Strongyle* (στρογγύλος, η, ον, rounded) (Fig. X., *c*). A rhabdus well rounded off at each end. It will be convenient to convert this into "strongylate" when it is used as an adjective. Bowerbank's term for strongylate is "cylindrical."

4. *Tylote* (τύλωτός, knobbed; ῥόπαλα τυλωτά, clubs knobbed with iron) (Fig. X., *d*). A rhabdus terminating in a knob-like thickening at each end. No change will be made in the form of this word when it is used adjectively. The corresponding term used by Bowerbank is "bicapitate cylindrical."

(*b*) Forms of rhabdus with dissimilar terminations—

5. *Strongyloxea.*—A rhabdus with a strongylate esactine and oxeate ecactine. This corresponds to one form of Bowerbank's "acuate."

6. *Tylotoxea* (Fig. X., *f*).—The esactine of the rhabdus is tylote, and the ecactine oxeate. This corresponds to one form of Bowerbank's "spinulate."

7. *Oxystrongyle.*—The esactine is oxeate and the ecactine strongylate. This form is not distinguished by Bowerbank from the strongyloxea (acuate, Bowerbank).

8. *Oxytylote* (Fig. X., *e*).—The esactine is oxeate, and the ecactine tylote. This form is not distinguished by Bowerbank from the tylotoxea (acuate, Bowerbank).

9. *Oxyclad* (ὀξυς, κλάδος, ὁ, a young branch). The esactine is oxeate, the ecactine terminates in two or more secondary actines or "cladi."

10. *Strongyloclad.*—The esactine is strongylate, the ecactine cladose.

11. *Tyloclad.*—The esactine is tylote and the ecactine cladose. This and the two preceding terms will require to be used but seldom, since the number of cladi is usually three, and in this case, that of the most commonly characteristic spicule of the Tetractinellida, a special term will be used to designate the spicule, as in the following paragraph.

The Triæne[1] (τρίαινα, η, a trident).

This is a special case of the cladose rhabdus, in which the number of cladi proceeding from the ecactine is limited to three, which make with each other an angle of 120°.

[1] Although the triæne is here regarded as derived from a rhabdus by the appearance of three branches at its distal termination, yet the terminology employed does not exclude the other way of regarding it which is advocated by Vosmaer, for if as Vosmaer—possibly quite rightly—supposes it has been derived from a tetraxon, still the three distal actines—as they would be called on this theory—have become so far differentiated that they require to be distinguished, and may without prejudice be spoken of as branches or cladi.

The different parts of the triæne (Fig. XI.) are distinguished as follows:—The "rhabdome" (shaft) which corresponds to nearly the whole of the primitive rhabdus, *i.e.*, the whole of the esactine and the acladose portion of the ecactine, and the "cladome" which consists of the three cladi (rays, teeth, arms). The point at which the axial rods of the cladi originate from that of the rhabdome is the "genesis cladi" or cladal origin.

The cladi may themselves subdivide once, twice, or oftener; usually dichotomously in one plane. The proximal or undivided part of a cladus is then distinguished as the protocladus, the distal division, in the case of a dichotomous cladus as the deuterocladus,

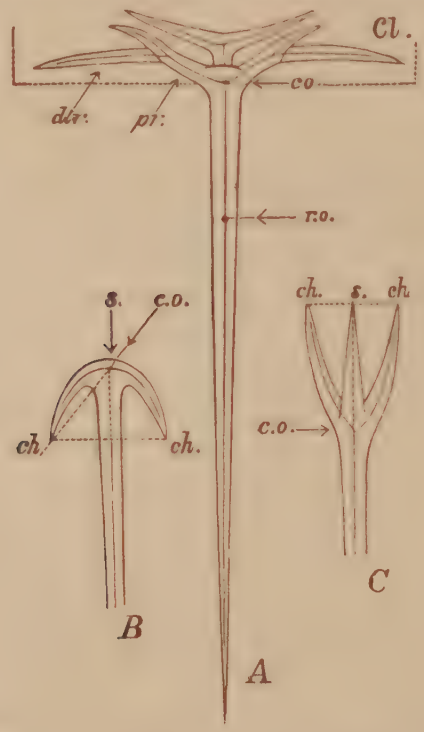


FIG. XI.—*A*. Dichotriæne; *r.o.*, origin of the rhabdome; *c.o*, origin of the cladome; *Cl.*, the cladome (this is included by the dotted lines, the rest of the spicule is the rhabdome); *pr.*, protocladus; *dtr.*, deuterocladus. *B*. Anatriæne; *c.o.*, cladal origin; *ch.–ch.*, chord; *ch.–c.o.*, length of cladus; dotted line from *s.* to the chord, sagitta. *C*. Protriæne; *c.o.*, cladal origin; *c.o.–s.*, sagitta; *ch.–ch.*, chord.

in a twice dichotomous cladus as the tritocladus, and in a thrice dichotomous cladus, the tetracladus.

An imaginary straight line joining the ends of two of the cladi is termed the *chord*.

A perpendicular from the origin of the cladome to the chord is the *sagitta*.

A straight line drawn from the cladal origin to the end of a cladus is taken as its length.

The length of the cladus, of the chord, and of the sagitta are the chief elements in the measurement of the cladome.

Varieties of the Triæne.

1. *Anatriæne* (anchor of Carter) (Fig. X., *a*).—The clads of the triæne are directed backwards even after diverging from the origin.

2. *Protriæne* (protrete-triæne spicule of Bowerbank) (Fig. X., *m*).—The clads are directed forwards making an angle of less than 45°, with the axis of the rhabdome produced.

3. *Plagiotriæne* (Fig. X., *b*).—The clads are directed forwards, making an angle of about 45°, with the axis of the rhabdome produced.

4. *Orthotriæne* (Fig. X., *l*).—The clads make an angle of between 80° and 99°, with the axis of the rhabdome produced. Usually the angle approaches 90°.

5. *Dichotriæne* (Fig. XI., *a*).—The clads of a plagiotriæne or an orthotriæne are dichotomous. The protoclads are almost always directed forwards making an angle of less than 90° with the axis of the rhabdome produced, i.e., the dichotriæne usually arises from a plagiotriæne. In some few cases the protoclads are so highly protrete as to suggest a protrete origin.

6. *Trichotriæne* (Pl. XXXI. fig. 10, *a*).—A plagiotriæne or orthotriæne in which the clads have become trifurcate.

7. *Phyllotriæne* (Pl. XXXII. figs. 8, 9).—The clads of an orthotriæne, or dichotriæne, or trichotriæne may increase at the lateral margins at the expense of the clathrome, and thus acquire a broadly expanded or lamellar form; the margins of the foliate clads thus produced are usually undulating or more or less divided. The phyllotriæne is only met with in the Lithistida.

8. *Discotriæne* (Pl. XXXI. fig. 1).—The clathrome is a disc in which separate clads are not distinguishable; and the axial rods representing them extend but a short distance from the cladial origin. This spicule like the preceding occurs only in the Lithistida. The phyllotriæne and the discotriæne are of great interest as furnishing the best evidence of the mode of evolution of the Lithistid desma: in the *dichotriæne* as in all normal triæne the axial rods of the clads extend close up to the termination of the clads, in the phyllotriæne they terminate at a distance from the ends of the clads, greater or less as the case may be, in the discotriæne they terminate much nearer the origin, extending but a very short distance into the clathrome, sometimes not more than 0·004 mm. Post the termination of the axial rods the disc grows by centrifugal additions to its margin, from the centre of the cladial cone. While the clathrome thus follows the same course of growth as the desma of the discotriæne, the clathrome usually retains the normal spicular character, so that the discotriæne combines in itself the characters of the desma and the ordinary spicule. The essential character of the desma would thus appear to arise from emancipation from the control of the axial rods, which govern the growth of all other triæne forms.

9. *Amphitriæne* (Fig. X., *o*).—Both actines of a rhabdome terminate in a cladome.

The cladome of one end may be similar or dissimilar to that of the other (homopolar and heteropolar amphitriænes). Thus the cladome at one end may be dichocladose, and at the other simply cladose.

It will be observed that in the case of the triæne we have followed a different method to that we pursued in the case of the simple rhabdus; since we have here retained the prefix "amphi-," and as a matter of fact left some such prefix as "mono-" to be understood in the case of the other triænes; this is done as a matter of convenience, the monotriænes being the prevalent forms, and the amphitriænes of rare occurrence; thus there is convenience in dispensing with the prefix "mono-," as its place can be better occupied.

10. *Centrotriæne* (Pl. XXXV. fig. 23).—The cladi arise from the centre of the rhabdome, *i.e.*, the actinal and cladal centres correspond. Though the cladi thus become geometrically actines, we shall continue to speak of them as cladi, since they are differentiated from those of the rhabdome as well as homologous with the cladi of other triænes.

In some cases the triæne is reduced by the loss of one or two of its cladi, it then becomes a diæne or monæne as the case may be; the varieties of these reduced forms are denoted like those of the triæne by the prefixes "pro-," "ana-," &c.

We now pass on to the classification of the monaxon Monactine, or Style.

Forms of the Style.

1. *Style* (*stilus*, a style, Vosmaer) (Fig. X., *g*).

When the single actine is strongylate at the origin and oxeate at the termination the term style is used without qualification.

2. *Tylostyle.*—A style which is tylote at the origin Fig. X., *h*).

Both the rhabdus and the style may differ in other respects as well as in the character of the termination: such differences are indicated by descriptive additions; thus they may be fusiform, cylindrical, or nearly conical, or immeasurably thin (trichodal, τριχωδης, hair-like), smooth or spined, and if spined partially or wholly. The spines also differ in character: they may be large, small, erect or inclined, sharply pointed or rounded off, and so forth; for very minute spines Carter uses the term "microspines"; I have not felt at liberty to adopt this term, although it has the temptation of brevity, because it is a hybrid of Greek and Latin.

The Rhabdocrepid Desma.

Those megascleres of the Lithistida that form the characteristic skeletal network differ in some important respects from the megascleres of other sponges, and are here distinguished as "desmas"[1] (δέσμα, ατος, το, a bond). They are formed usually by the deposition of successive layers of silica upon an ordinary spicule, the axial rod of which early suffers an arrest of development (Pl. XXXIII. fig. 8; Pl. XXXIV. fig. 1; Pl. XXXV. figs. 5–10, 35–42). The layers which are deposited after the arrested growth of the fundamental spicule, or, as it may be termed, the "crepis" (κρηπίς, ιδος, ἡ, a kind of man's boot, or generally a foundation), are at first concentric with it, but subsequently grow out into irregular branches, cladi, and tubercles which are altogether independent of it. The crepis may be either a monaxon (Fig. X., *p–r*), or a tetraxon; the former, which alone is the immediate subject for consideration, is most usually if not always a small strongyle (microstrongyle). That part of the adult desma which is formed by the deposition of concentric layers immediately around the crepis may be termed the "epirabd." The fully grown forms of a rhabdocrepid desma are described under the species in which they occur, and we need not further allude to them here except to point out the fact that in many cases examples of rhabdocrepid desmas will frequently be encountered which, notwithstanding their difference in origin, are not to be distinguished from normal forms of tetracrepid desmas, and thus it may be and undoubtedly is in some cases difficult to say, in the absence of a visible crepis, whether a desma is rhabdocrepid or tetracrepid, but this difficulty is not a matter of any consequence in the examination of recent species, since, if the crepis is not visible in one desma it will be in another; it is only in the fossil sponges that any real difficulty can occur, and here it may generally be met by the fact that while some rhabdocrepid desmas are remarkably like tetracrepid ones, the converse on the other hand is not generally true, and thus if all the desmas of a fossil sponge are tetracrepid in general appearance, we may assign it to the tetracrepid group of Lithistids with great probability, even when neither the crepis is visible nor its cast; on the other hand, if only a few of the desmas are tetracrepid in appearance and the rest rhabdocrepid, we may refer the sponge to the rhabdocrepid division, undisturbed by the few exceptional forms which appear to point to a different conclusion.

Group II. Classification of the Tetraxons.

1. *Tetractine.*—When all four actines of a tetraxon are present it is of course a tetractine, but as the full designation of this required to distinguish it from a tetractinose

[1] Of course the plural form should be "desmata," but in this and all similar cases (dragma, sigma) I have ventured to form the plural according to the common English rule.

triaxon is tetractine tetraxon, we shall substitute for it the equivalent "calthrops" (χηλή, ἡ, a horse's hoof; τρῦπάω, to pierce through; a hoof-piercer). The singular and plural forms of this word are the same. The "h" is inserted for euphony.

2. *Triod* (τρί-οδος, ἡ, a meeting of three roads, Lat. *trivium;* here abbreviated on the example of "tripod"). When one actine is suppressed, the remaining three come to lie in one plane, and a triradiate spicule or triod, the commonest form of spicule in the Calcispongiæ, results. In von Lendenfeld's account of the spicule-nomenclature, which is taken from that accepted by our conference in London, this form is assigned to a triaxon group without notice of the fact that the triaxon group is that of the three rectangular axes.

Modifications of the Calthrops.

Modifications occurring frequently enough for special designations are not met with, occasionally one or more of the actines may dichotomise, but no instance is known in which this occurs other than as an isolated variation.

Modifications of the Triod.

As these rarely occur in the Tetractinellida, but are almost restricted to the Calcispongiæ, we shall not need to consider them here.

Tetracrepid Desma.

This sclere (Pl. XXIX. figs. 7, 8) is formed by the deposition of silica upon a small calthrops (microcalthrops), it presents therefore four rod-like arms proceeding from a centre, these (which as they immediately invest the actines of the crepis may be termed "epactines") may branch once or oftener, and usually terminate by subdividing into tubercles. In the Lithistida generally the desmas are united by the intergrowth, without fusion, of such tubercles, or by the growth of the ends of the cladi of one desma over some part of another, such as the sides of the epirabd or end of the epactine; this mode of union we shall term "zygosis," and the tubercles or laminæ by which it is effected will be distinguished as "syzygial," the union itself being a "syzygy."

Acrepid Desma.

In one group of Lithistids (Anomocladidæ) the desma does not form upon a crepis, at least not a spicular crepis; it presents a massive centrum, with what appears to be a large nucleus, and which may indeed actually be the nucleus of a crepidial scleroblast,

which has ceased to secrete its sclere; variable numbers of actines proceed from the centrum, usually from four to twelve; when, as is usual, only four or five are present, they proceed from one face of the centrum, viz., that which is directed centripetally, and terminate by abutting with expanded ends on the centrifugal face of the centrum of the desmas situated in the next row further inwards. From the centrifugal face of the centrum actines are seldom produced, but a thick bushy growth of spines replaces them, these more or less conceal the syzygial ends of the actines, rendering the nature of the zygosis obscure.

Class II. Microscleres (Microsclera).

Comparatively small or "flesh" spicules.

These, which are perhaps the most interesting group of spicules, since it is from them that the megascleres have been derived, and since they still present us with a remarkable

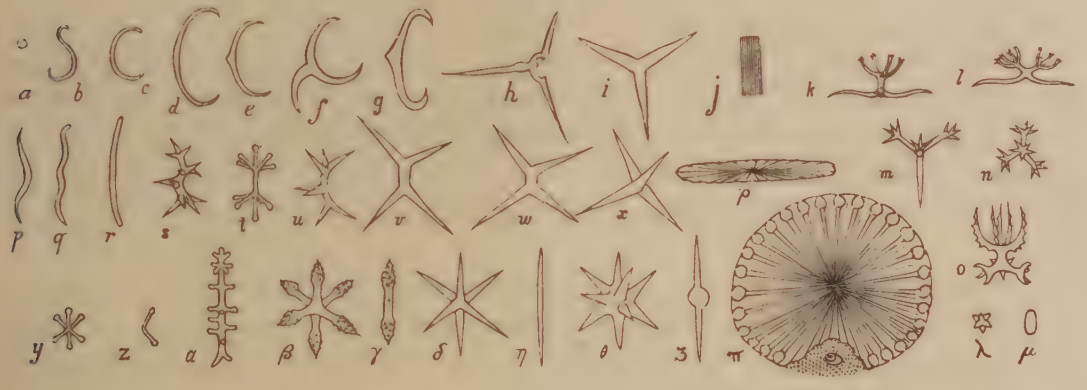


Fig. XII.—*a*, Globule; *b*, *c*, sigmaspires; *d*, sigma of a Holothuroid; *e*, centractinate sigma of a Holothuroid; *f*, microtriod with curved rays, produced from *e* by overdevelopment of the centractine; *g*, centractinate sigma of a sponge; *h*, microtriod of *Placina*, retaining traces of its sigmate origin; *i*, microtriod; *j*, orthodragma; *k*, monolophous microcalthrops; *l*, dilophous microcalthrops; *m*, trilophous microcalthrops; *n*, tetralophous microcalthrops; *o*, candelabrum; *p*, toxa; *q*, spirula; *r*, microstrongyle, derived from a sigma; *s*, spiraster; *t*, amphiaster; *u*, metaster; *v*, *w*, plesiasters; *x*, microcalthrops; *y*, chiaster; *z*, reduced chiaster; *α*, sanidaster; *β*, anthaster; *γ*, microxea produced by reduction of *β*; *δ*, oxyaster; *η*, microxea resulting from its reduction; *θ*, spheraster; *ζ*, centrotylote microxea resulting from its reduction; *λ*, pycnaster; *μ*, microstrongyle resulting from its reduction; *π*, spherical sterraster, showing the nucleus situated in the hilum; *ρ*, elongate sterraster.

series of transitions within their own limits, are divided into two chief series, the radiate or astral, and the curvilinear or spiral. There are some few forms that cannot properly be said to belong to either of these groups, but they are so few and exceptional that it seems preferable to include them with the forms to which they are most nearly allied by descent, than to create special groups for their reception.

Series 1. Spires (σπεῖρα, ἡ, Lat. *spira*, in plural the twisted coils of a serpent, called spires by Milton).

These spicules have the form of a screw helix, of less or more than one revolution and of various pitch.

1. *Sigmaspire* (Fig. XII., *b*, *c*).—A slender rod twisted through about a single revolution of a spiral. This spicule has the form of the letter "c" or "s" according to the direction in which it is viewed, and has in consequence been regarded by authors as a variable spicule, sometimes twisted in one manner and sometimes in another, but the two forms are always associated in the same sponge, and by causing one of them to turn round it will be found to assume the appearance of the other, so that there can be no doubt as to its spiral form. By making little models of screw spirals with pieces of wire the form of this spicule and its different appearances according to circumstances will readily be understood.

2. *Toxaspire*.—A spiral rod in which the twist a little exceeds a single revolution. The pitch of the spiral is usually great and the spicule consequently appears bow-shaped when viewed laterally (tricurvate).

3. *Polyspire* (spirula, Carter) (Fig. XII., *q*).—A spire of two or more revolutions. It makes but little difference whether we employ the term spirula or polyspire. I am myself inclined to adopt Carter's term since it has priority, and the term polyspire is only introduced here to show the relations of this spicule with other spires; not by any means out of that desire for uniformity, which is "the curse of small minds."

4. *Sigma* (Fig. XII., *d*).—A slender rod-like spicule curved in the form of the letter "c." This spicule is not spiral though it probably arises from a sigmaspire by increase in size and loss of the spiral twist. It does not occur in the Tetractinellida.

The toxa and chela which originate from the sigma:—

5. *Toxa* (Fig. XII., *p*).—A bow-shaped spicule, also without spiral twist. It may sometimes develop from the sigma and sometimes from an aster, as in *Isops* (*Caminus*) *apiarium* (Pl. XLIII. fig. 10).

6. *Chela*.—This spicule, which also arises from the sigma, does not occur in the Tetractinellida.

7. *Globule* (Fig. XII., *a*) or spherule.—A minute spicule which presents a more or less spherical form. This spicule occurs in the Tetillidæ associated with sigmaspires; it is also found in other sponges (*Caminus sphæroconia*), but in them is probably derived from an aster by reduction, while in *Tetilla* it is possibly a primitive form. It is placed with the spires for want of a better place, to avoid making a special group for it.

The Dragmas.

These spicules, which are secreted several together in the same scleroblast, are placed as an appendix to the microscleres which are secreted each in a single scleroblast, since they do not differ from them in form, and it would be cumbrous to subdivide the microscleres into two groups, say the monogennema and syngennema.

1. *Sigmadragma.*—A sheaf of sigmaspires.

2. *Toxadragma.*—A sheaf of toxaspires.

3. *Orthodragma* (Fig. XII., *j*).—A sheaf of straight trichodal rods (Pl. XVIII. fig. 13). In describing *Dragmastra* (*Stelletta*) *normani*, I used the term trichite-sheaves for these spicules. The term trichite may be retained to denote the individual hair-like rods of which the sheaf is composed. "Trichodal" will be used as an adjective to denote exceptional tenuity.

Series II. Asters.

Section (*a*) *Streptasters.*

The asters are divided into two subsections, the true asters or euasters, and the streptasters or those in which the actines do not proceed from a centre, but from a longer or shorter axis, which is usually spiral.

1. *Spiraster* (Fig. XII., *s*).—A spire of one or more turns, produced on the outer side into several spines.

2. *Metaster* (Fig. XII., *u*).—A spire of less than a single revolution, with fewer but relatively longer spines than the spiraster. The spire sometimes has the appearance of a straight rod; this may be due to the aspect in which it is presented, and to the fact that it does not make a whole revolution. It forms a link between the spiraster and the next form—the plesiaster.

3. *Plesiaster* (Fig. XII., *v*, *w*).—The spines, or as they may now be termed, actines, proceed from a very short straight axis, so that they almost appear to radiate from a common centre. In forms with less than four actines no axis as a rule is discoverable, and the actines may actually proceed from a centre; in those with more than three, the axis can always be made out, though in certain positions of the spicule it appears as though all the actines proceeded from a centre except one, which proceeds from one of the actines arising at a little distance from the common origin; in this case the part of the actine which extends between the common centre and the origin of the excentric actine represents the axis. The plesiasters are always much larger when fully grown than the metasters, with which they are associated, and the metasters are larger than the spirasters; the three forms present a perfect gradational series, so that it is frequently

difficult when they all occur associated in the same sponge, to distinguish in every case one variety from the other.

4. *Amphiaster* (Fig. XII., *t*).—The actines form a whorl at each extremity of the axis, which is straight. The direction of the axis is frequently continued by a single actine at each end.

5. *Sanidaster* (σανίς, ίδος, ἡ, a cross, or rather a plank to which offenders were nailed as to a cross) (Fig. XII., *a*).—A slender rod-like axis bearing spines at intervals along its whole length, those from the sides are directed from it at right angles, those at the ends diverge from it obliquely. The spines may or may not be spirally arranged. This spicule appears to arise as a modification of the euaster, while the amphiaster is more usually a modified spiraster.

Section (*b*) *Euasters.*

In the euasters the actines always proceed from a common centre, about which a concentric deposition of silica may take place, producing a larger or smaller centrum. The prefix "eu" is only used in a general sense, there are so many varieties of this form of aster that the place it would occupy is needed for other more specific prefixes.

1. *Chiaster* (from the Greek letter χ, to which some forms present a fanciful resemblance). A minute aster with very slender cylindrical actines, terminally tylote or not, or truncate (Fig. XII., *y*).[1]

2. *Pycnaster.*—A minute aster with short conical strongylate actines. This is always a small aster and might be regarded as a variety of the chiaster (Fig. XII., λ).

3. *Oxyaster.*—An aster with a small centrum or none, and conical oxeate actines (Fig. XII., δ).

4. *Spheraster.*—An aster in which the centrum is large, *i.e.*, with a diameter equal to or exceeding one-third of the length of the actines (Fig. XII., *θ*).

5. *Sterraster* (Fig. XII., *π*, *ρ*).—An aster with exceedingly numerous actines which become soldered together by subsequently deposited silica, which extends almost as far as their extremities, forming a kind of centrum. In form the sterraster varies considerably; it may be spherical, ellipsoidal (oblately or prolately) disciform, lozenge-shaped, or lath-shaped with rounded ends. As a rule, to which there are several exceptions, the actines are expanded at their extremities and produced into from four to six recurved spines, which serve for the attachment of fusiform cells (myocytes or inocytes) by which they are united into a continuous layer. Over an oval area on one side a

[1] I at first assigned this name to a small aster with no centrum, and few actines, and those terminally tylote; the whole spicule being not altogether unlike a Greek χ. Subsequently, however, I found this variety passing into another with very numerous actines, and sometimes with an obviously developed centrum, without losing its general character, and, finally, I found it represented by forms in which the terminal tylus, which I had thought characteristic, is absent; thus I have had to extend the application of the term till its original meaning has quite disappeared.

conical depression occurs, or, when this is absent, a space devoid of spines; this is the hilum, and either contains, or marks the position of, the nucleus of the scleroblast. When the hilum is a cavity it results from the fact that the actines which radiate towards it are shorter than those which occur elsewhere, and shorter as they are traced from the margin towards the centre of the hilum; the ends of the actines which lie within the hilum are not expanded and spined, but simply rounded and roughened.

Reductions of the Aster.

In many sponges asters occur in which the number of actines is both few and variable, presenting a mixture of forms which repeat many of those of the megascleres. Thus in the same sponge triaxons with from six to three actines are met with, associated with tetraxons of from three to four actines, and monaxons with one or two actines; when these forms occur confusedly mixed together as variations of the aster in one and the same sponge, distinct names are not given to them, but when one or other of them is a constant characteristic of a particular species special names become necessary.

Thus we have a series of tetraxon microscleres and of monaxon microscleres: the latter we shall term microrabds, the former microcalthrops and microtriods. The microtriods do not call for special notice.

The microcalthrops.—This is an aster which in its simplest form repeats the calthrops *in parvo*. It presents, however, several interesting modifications, most of them described by Schulze, which are peculiar to it; these are chiefly produced by cladosis of the actines.

1. *Monolophous microcalthrops* (Fig. XII., *k*).—A microcalthrops in which a single centrifugally directed actine is cladose at the extremity.

2. *Dilophous microcalthrops* (Fig. XII., *l*).—Two centrifugally directed actines are similarly cladose.

3. *Trilophous microcalthrops* (Fig. XII., *m*).—Three centrifugally directed actines are similarly cladose.

4. *Tetralophous microcalthrops* (Fig. XII., *n*).—All four actines are similarly cladose.

5. *Candelabrum* (Fig. XII., *o*).—A tetralophous microcalthrops in which the single centrifugal actine differs from the three basal actines, which are similar to each other; the difference may consist in the form, size, or direction of the cladi. Schulze extends the definition so as to include all cladose microcalthrops in which the basal actines are cladose and curved.

The microrabdus or microrabd (Fig. XII., γ, η, ζ, μ).—This is an aster in which all actines but two directed along the same axis are suppressed. In some few instances the microrabd is derived from a spire (*Tetilla australiensis*).

1. *Microxea.*—A minute oxea which may be smooth (Fig. XII., η) or spined (Fig. XII., γ), centrotylote (Fig. XII., ζ) or not.

2. *Microstrongyle.*—A minute strongyle, smooth, or spined, centrotylote or not (Fig. XII., μ). This spicule is the "bacillus" of Carter. The centrotyle in both forms of microrabd represents the centrum of the aster from which it has been derived. These spicules are of polyphyletic origin, an aster in one genus of sponge being represented by a microrabd derived from it in another closely related genus.

Phylogeny of the Scleres of the Demospongiæ.

The megascleres in their ontogenetic development commence as very minute spicules, which if their growth were arrested would be indistinguishable from microscleres; the leading forms of the megascleres are repeated by the microscleres; and in the simplest Tetractinellid sponges the skeleton consists wholly of microscleres, without any admixture of megascleres. On these and *à priori* grounds we may fairly infer that the megascleres have a microscleral origin. The interest attaching to the microscleres is in inverse ratio to their size; they not only represent the primitive material from which the megascleres have been derived by increased growth and mechanical selection, but they present among themselves most perfect transitional series which help us to understand the history and causation of spicular forms; while last but not least they reveal in an unexpected manner the filiation between the different families of sponges constituting the order Demospongiæ.

The simplest form of microsclere is probably the globule, which occurs associated with the sigmaspires of the genus *Tetilla*, and next to this the sigmaspires themselves. Within the family Tetillidæ the sigmaspire presents but slight modifications, but those which do occur are of great interest.

1. The transition from the sigmaspire to the toxaspire can be traced in *Chrotella macellata* (*vide* p. 20).

2. From the sigmaspire to a curved microstrongyle in *Tetilla stipitata*, Carter (*vide* p. 49).

3. In *Tetilla geniculata*, Marenzeller (p. 46), the sigmaspire is centrally tylote. This seems to point to the globule as the original form of the sigmaspire, the central tylus representing the persistent globule.

4. In *Tetilla japonica*, Lampe (p. 46), and in *Craniella atropurpurea*, Carter (p. 50), the sigmaspire becomes spined, and in the latter of the two sponges it acquires an unusually large size, though the spines remain small in proportion to the spire. The largest spines, however, occur at the termination of the spire and thus suggest a tendency towards the Desmacidine chela.

In Demospongiæ which are not Tetractinellida we meet with sigmas, which may be

regarded as sigmaspires reduced to arcs, a view which is supported by the occasional occurrence of S-shaped forms as apparently accidental variations of the normal C-shaped sigma. I have myself no doubt as to the derivation of the Desmacidine chela from the sigma, but as my views on this point are at variance with those of my colleague, Mr. Dendy, and as this form does not occur in the Tetractinellida, I shall not now discuss the question.

The spiraster, which we shall next consider, is the crux of sclerological studies. It may be conceived as originating in two different ways, which, however, are not mutually exclusive. It may arise as a spiral extension of the centrum of a euaster, or by the development of spines about a sigmaspire; the former view appears to have been generally accepted, I fancy rather as a tacit assumption than as a result of investigation.

In the Theneidæ there is good reason to believe, at least so it seems to me, that the spiraster originates from a sigmaspire or polyspire, for in its smallest forms, which are probably the least removed from the ancestral, it always presents a well-marked spire of about two turns, with comparatively small spines, which are produced at intervals in a radiate direction from the outer side of the spire. The spire is in this case the most conspicuous part of the spicule, and since we have already found the sigmaspire becoming spined in the Tetillidæ, which are amongst the simplest sponges of the Tetractinellida, we are fairly led to conclude, in the absence of evidence to the contrary, that the sigmaspire is the parent of the spiraster.

Further, in the Theneidæ the euaster would appear to proceed from the spiraster and not the spiraster from the euaster; thus as the spiraster increases in size the spire becomes reduced, and the spines increased in length, till the various forms of metaster result; the increase in size continuing, the spire sinks into insignificance, and the spines acquire comparatively colossal proportions; the plesiaster, which can thus be traced through a continuous series of transitions from the spiraster, is scarcely distinguishable from the euaster. In the lower forms of the genus *Thenea* the course of development proceeds no further, but in others the plesiaster is absent and its place taken by a euaster, which only differs from the plesiaster in the fact that its actines all proceed from a common centre.

While the spiraster can thus be traced through a perfect gradational series into the aster, the converse is not true, and I know of no instance but one (*Placospongia*) in which sponges characterized by euasters (Stellettidæ, Geodiidæ) present any indications of a tendency for these to revert to the spirastral form; the modifications of the aster are of a completely different kind, being chiefly in the direction of a reduction in the number of the actines.

While some asters thus originate from spirasters, and these again from sigmaspires, it is quite possible that there are other asters possessing a different history; thus in *Placina*, the simplest of all Tetractinellida, microcalthrops occur which, unless this sponge is to be regarded as a reduced Theneid, not a very likely supposition, must be regarded

as of independent origin. Nothing in the characters of the spicules of *Placina* seems at first sight to suggest for them a simpler origin, yet a general consideration of the subject leads me to suspect that they also may be traced back to a sigmaspire, but not through a genuine spiraster. Bowerbank represents as the spicules of an undescribed sponge several forms of sigma with one or more rudimentary actines proceeding from the centre; these spicules, which Bowerbank [1] terms exter-umbonate, inter-umbonate, and bi-umbonate bihamates, we may incorporate into our system of nomenclature as centractinate sigmas. The particular form, which is of interest as bearing on the present enquiry, is that in which the actine is directed outwardly from the convex side of the sigma, and to this alone we shall refer in using the term centractinate sigma in the following remarks. The first point of interest is that such spicules are by no means confined to the Sponges, but occur also in the Echinodermata, and in the Nudibranch Molluscs, and that not at all uncommonly. Next in both these groups, the centractinate sigma passes into a centractinate form in which the actine is of considerable size in relation to the rest of the sigma; so large is it that the spicule presents a close resemblance to a triod, into which form indeed it passes by the straightening of the two arms of the sigma, one on each side of the actine; finally, by the appearance of an additional actine the triod passes into a microcalthrops. There is thus suggested for our consideration the possibility of a similar origin in the case of the microcalthrops of *Placina*. In this sponge microtriods and microxeas are almost as plentiful as microcalthrops, and they are always distinguished either by a curved inflexion at the centre (Pl. XLIII. figs. 14, 14*a*), or by two of the actines forming together a regular arciform curve. Thus, what little evidence we can adduce is in favour of at least a double origin for the aster, and we may suppose that in some cases it has been developed from the sigmaspire through the spiraster, and in the others from the same spicule through the sigma and its centractinate modification.

In both *Placina* and most species of *Thenea* the mesoderm is not largely developed, and it is possible that this is connected with the comparatively few actines which the asters in these sponges possess; with a larger development of mesoderm or perhaps from other causes the aster acquires additional actines; with increase of size, and sometimes without, the aster becomes reduced and furnishes the microrabd or even a microstyle, and indeed in some sponges a globule, so that this last-named spicule may arise in two ways either as a primitive form or as a reduced aster. The megarabd or rhabdus is in all probability an overgrown microrabd. The style may have been derived from a microstyle, but transitions from the rhabdus to the style are of such frequent occurrence that it may with equal and perhaps greater probability have descended from the rhabdus. The same is true of the tylostyle, and the shortening of the rhabdus may proceed so far as to produce the sphere. These modifications of the

[1] Bowerbank, Mon. Brit. Spong., vol. i. figs. 115–117.

rhabdus occur as accidental varieties in sponges of which the rhabdus is the characteristic spicule (*Epallax callocyathus, Pœcillastra schulzii*).

The origin of the triæne is a subject on which opinions differ: on *à priori* grounds it may with equal probability be derived from the calthrops by a lengthening of one of the actines or from a rhabdus by terminal cladosis of one of the ends, naturally of the centrifugal end; the former hypothesis has in its favour an appearance of simplicity; the latter is supported by a great deal of direct evidence, both ontogenetic and morphological.

In the simplest triæne-bearing sponges, viz., the Tetillidæ, which are not much more complex than the Placinidæ, the anatriæne at its earliest recognisable appearance is an oxytylote, with a very feebly expressed tylus; the tylus increases in size, and a single cladus appears; and in the young sponge, while still within the body of the parent, this single cladus acquires a considerable size before the remaining cladi appear.

The strength of the argument to be drawn from this fact would be greater, were it not for the possibility that it may be merely an adaptive character, standing in relation to the advanced stage of development reached by the young sponge before it quits the body of the parent; and this seems the more likely as the body of parent sponge is invested with a strong fibrous and spicular cortex, through which the young sponge, which may be as much as 1·75 mm. in diameter, must make its way to the exterior, in what manner we know not (*vide* p. 39). The argument may be supposed to be further weakened by the fact that in the adult sponge all three cladi appear to develop simultaneously. While the appearance of one cladus earlier than the rest may not be a matter of any special significance, the origin of the triæne from an oxytylote is a very strong argument in favour of its rhabdal origin. The protriæne also develops from an oxytylote, but all three actines appear simultaneously, even in the young sponge; they are at first excessively minute, the merest spines, but subsequently attain considerable size (*vide* p. 13, Pl. V. figs. 10, 15).

Whatever doubt may be felt as to the value to be attached to the appearance of only a single cladus in the young Tetillid, the evidence in the case of *Thenea*, though of a different nature, seems to admit of but little dispute; in very young examples of this sponge, which do not develop within the parent, the anatriæne of the radical filaments commences as an oxystrongyle, subsequently numerous small spines appear at the strongylate end, and as these are absent from the adult spicules we may conclude that three of them by over-development become the adult cladi, the rest being suppressed; in some instances the strongyle presents in the young sponge only one or two strong spines, which are evidently developing cladi, and thus we have a variability in the number of the cladi of the early form of triæne, such as we might expect if it were, as we suppose, derived from a rhabdus with an at first spined and subsequently cladose termination.

In the Stellettidæ the triænes, as in all triænose sponges, always both in the adult and young sponge, give evidence of an early oxytylote stage (*vide* p. 144, Pl. XIII. figs. 16, 20).

The morphological argument appears scarcely less strong than the ontological; thus the form of the rhabdome of the triæne is in many cases, especially within the Tetillidæ, suggestive of a rhabdal origin. It is frequently fusiform, and so closely resembles the associated oxeas, that with the cladome removed it cannot be distinguished from them. The resemblance is enhanced by the anisoactinate character of the oxeas, the centrifugal actine of which is usually far shorter and therefore apparently stouter than the centripetal. The fusiform anisoactinate oxea has every appearance of homology with the anisoactinate fusiform rhabdome of the triæne: the morphological centre of the oxea lies between the two actines, and if the rhabdome of the triæne is homologous with it, its morphological centre likewise lies somewhere in the middle of its thickest part and not at the cladal origin.

Another point in favour of the rhabdal origin of the triæne may possibly be found in the extension of the rhabdome beyond the cladal origin (*vide* p. 13, Pl. V. figs. 8, 9). The existence of the centrotriæne and the amphitriæne also suggest a secondary rather than a primary origin for the cladome.

Finally, the position of the nucleus of the scleroblast is a strong point in favour of homologising the rhabdome of the triæne with a rhabdus; thus it is situated in the case of the Tetillid triæne upon the rhabdome at or about the point where its diameter is greatest, and it occupies a similar position in the associated oxeas, so that if we assume that the nucleus corresponds in position with the actinal centre, the homology of the rhabdome with the rhabdus would be proved. In the triænes of other Tetractinellida, not Tetillidæ, the scleroblastic nucleus never occurs in the region of the cladal origin but always from about one-third to one-fifth the length of the rhabdome distant from it. The only fact which I have come across at all opposed to the view here advocated is furnished by the very young dichotriænes of *Thenea* and *Stelletta*, these sometimes present a rhabdome which is shorter than the cladi, and since in the adult sponge the rhabdome is several times longer than the cladi, it follows that the scleroblastic nucleus may be shifted away from the cladal origin with the growth of the rhabdome, and thus that its position in the adult spicule is a secondarily acquired one. I have never seen the scleroblast of these young dichotriænes, and so can say nothing as to the position of its nucleus, but in the Tetillidæ it is situated in the young triænes as far from the cladal origin as in the adult.

Again certain general considerations may be adduced in favour of the rhabdal origin of the triæne; thus if we trust to the ontogenetic evidence furnished by the Tetillidæ and the Stellettidæ, we shall be led to suppose that the rhabdus first became modified into an oxytylote and subsequently spines originated from the tylus, and if instead of these families we consider the Theneidæ, we shall have to assume an oxystrongyle as the

first stage of transition instead of an oxytylote, not a great difference, and we shall also admit that the number of spines may at first have been less definite in number than they are now in the fully established triæne. If this is the teaching of ontogeny we might expect to find it confirmed by the occasional occurrence of spicules persisting in the intermediate stages of development, and these are not necessarily to be sought for in closely related families, for if the evolution of spicular forms has been due to the action of general causes, we should expect under similar circumstances to find similar forms evolved. The existence of the intermediate forms which theory predicates is a matter of notoriety: thus in the Desmacidinæ, which have probably descended from the same branch as the Tetillidæ, two closely related species have been described as possessing spicules which differ from the strongyloxeas (*Rhaphidotheca marshall-halli*, Kent,[1] and *Rhaphidotheca affinis*, Carter[2]) forming the greater part of the skeleton, by the presence of a large tylus in place of the usually oxeate distal termination. Again in the Suberites, which are probably not very closely related to the Tetractinellida, two quite different species (*Prototeleia sollasi*[3] and *Radiella schoenus*[4]) have been adduced as furnishing similar evidence; in the latter of the two species the tylotoxea, which forms the chief radiating spicular fibres of the sponge, occasionally becomes enlarged at its distal end into a large tylus, of more or less irregular shape, but sometimes almost spherical and always roughened by an irregular and minute spination; in the first-named species a minute cortical spicule is present, sometimes of a tylote form, sometimes with the distal tylus produced into an unascertained number of recurved spines. The resemblance of this spicule to an anatriæne is obvious, though the number of the cladi, for such the recurved spines may be fairly termed, does not appear to have attained that constancy which usually distinguishes the triæne; Dendy and Ridley state that though they could not quite convince themselves yet they believe the number to vary from three to four. In *Acarnus innominatus*, as Dendy and Ridley point out, a tyloclad exists with a cladome of four cladi, and in *Acarnus ternatus* a similar spicule with three. These instances, however, only suggest the independent origin of cladose spicules in different groups of sponges, and do not furnish us with persistent intermediate stages, as do the distally tylote rhabdi of *Esperia marshall-halli* and *Radiella schoenus;* to guard against misconception I may as well add that I do not for a moment suppose that the spicules last alluded to stand in any close genetic relation to the true triæne, as it exists in the Tetractinellida, they also are independently evolved forms, but persist in a stage through which we may assume the triæne to have passed. In the succeeding chapter on the origin of spicular forms I shall attempt to show that a rhabdal origin of the triæne is not inconsistent with a general theory of spicules.

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. i. pp. 4, 6, pl. xv.
[2] *Journ. Roy. Micr. Soc.*, vol. ii. p. 497, pl. xvii. figs. 1–34.
[3] Dendy and Ridley, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xviii. p. 153, pl. v.
[4] Sollas, *op. cit.*, ser. 5, vol. ix. p. 163.

The calthrops may have been derived from a triæne by shortening of the rhabdome, or from a microcalthrops by increased growth. Possibly it has been in some cases evolved in one way, in others in the other; thus in *Tetilla merguiensis* it probably arises from the protriæne by a reduction of the rhabdome; in *Pachastrella* it has the appearance of an overgrown microcalthrops, but considering the close alliance of *Pachastrella* with *Pacillastra* (*Normania*), in which both triænes and calthrops occur, the latter possibly derived from the former, this appearance may be misleading, and I prefer to leave the question open.

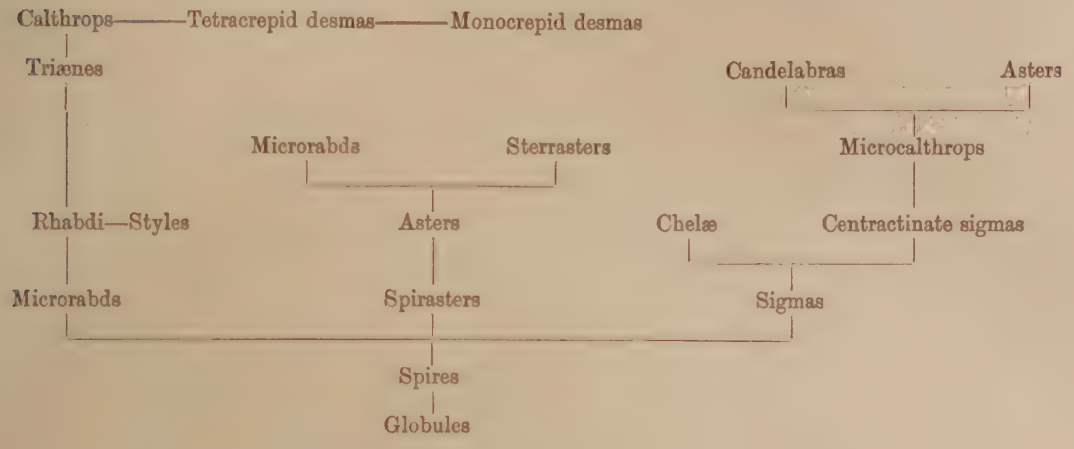
In concluding this discussion I would point out the purely hypothetical nature of the view which regards the triæne as derived from the rhabdus, and there is a good deal to be said for an opposite hypothesis which would derive the triæne from the microcalthrops; thus *Pacillastra* may be in a direct line of descent with *Placinastrella* (*Placinastrella copiosa*, Schulze), and in this sponge triænes and calthrops, both apparently derived from microcalthrops, occur: and further, it is possible though not probable that the dichotriæne of *Thenea* may have been derived from the trilophous microcalthrops of *Placina trilopha*, Schulze. In that case opposing evidence might be reconciled by attributing a different origin to the Tetillidæ and the Theneidæ. The spiraster in the latter family, however, would seem to preclude such a separation, if as seems probable this spicule has originated from a sigmaspire. If on the other hand we could derive the sigmaspire from the spiraster, the probability of the descent of the triæne from the calthrops would be enhanced, indeed the simplicity which at once follows the adoption of this view is so great that nothing but the stubbornness of the ontological data prevents me from adopting it.

The Lithistid desma, since in some families it commences as a microrabd and in others as a microcalthrops, might be supposed to be of dual origin, and to this view I felt forced when first studying this group; subsequent investigation has convinced me, however, of the truth of Oscar Schmidt's observations, which prove that a gradual transition from the tetracrepid to the monocrepid desma occurs in species of *Macandrewia*.

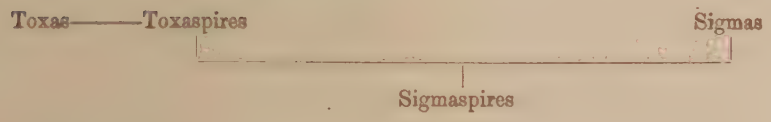
The study of the transformations of the aster will help us to understand this, for as already noticed we not unfrequently find it passing into a microrabd, and we are led to suppose that the microcalthrops which serves as the crepis of the tetracrepid desma has undergone in the monocrepid desma a similar reduction; such embryonal variation as this would seem to imply is not unknown in other groups of animals.

The transition is supposed to be from the tetracrepid to the monocrepid desma and not in the reverse direction, because several considerations, which will be discussed later, lead us to suppose that the Lithistids characterised by tetracrepid desmas were the first evolved, from Choristida allied most closely to the Pachastrellidæ.

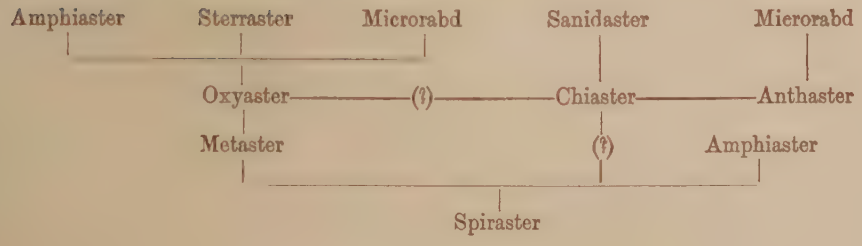
Affiliation of the principal forms of Spicules in the Desmospongiæ.



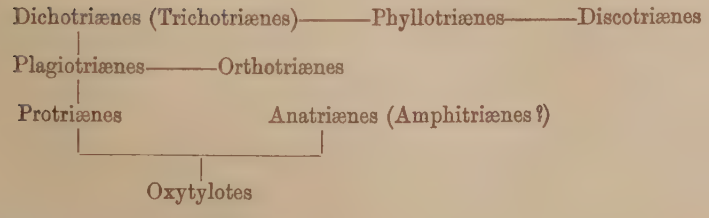
Affiliation of the Spires.



Affiliation of the Asters.



Affiliation of the Triænes.



Should it eventually appear that the triæne has not descended from a rhabdus, then the phylogeny of the scleres will be more consistently represented by the following scheme:—

In cases where forms mentioned in the preceding scheme do not appear in this, it will be understood that no change in the relations previously expressed is involved.

In attempting an explanation of the origin of the different forms of spicules in the following section, I have taken as a basis for argument the first of the two schemes.

Hypothetical Explanation of the Forms of Spicules.

The regular geometrical forms which characterise so strikingly the spicules of sponges and other organisms have been often commented upon, but the attempts to explain them are few.[1] Haeckel has attempted to connect the forms of calcareous spicules with the crystalline forms of calcite, but without success; since in the first place they cannot with anything approaching universality be reduced to a rhombohedral type, and in the next precisely the same forms are presented by other spicules not composed of crystalline material, but of a colloid, either mineral, such as opal, or organic, such as spongin. This not only proves that the forms of spicules are not determined by the same causes as give rise to crystals, but warns us against attempting to account for them by their molecular structure at all.

Again, not only are similar spicular forms presented by chemically different material, but they occur in widely diverse groups of organisms. Thus in the Foraminifera, though the test usually has the form of a more or less continuous superficial shell, yet in at least one instance (*Rotalia spiculitesta*, Carter)[2] it consists of separate calcareous spicules, which have the form of short, stout, fusiform, strongylate or tornote rhabdi. The

[1] This and the greater part of the following explanation were written in 1885. Schulze has since propounded an important theory of spicules.

[2] *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xx. pl. xvi., 1877.

Radiolaria also present spicular forms like those of Sponges, and there is also much in the character of the reticulation of their test which is of interest in our present enquiry. In the Echinodermata the forms of sponge spicules are frequently repeated, and not merely of calcareous spicules but of siliceous ones as well; thus sigmas and sigmaspires are far from uncommon, and the former are sometimes centrotylote, and sometimes centractinate, the centractinate variety passing into a triod with curved or straight actines; various forms of rhabdi, both smooth and spined, triods and dichotriods, calthrops, pentactine triaxons, and various irregular forms almost precisely similar to Lithistid desmas are of common occurrence.[1] In the Nudibranchiate Mollusca sigmas occur, which are sometimes centractinate and then pass into triods, which again give rise to oxeas; asters, strongyles, and tylotes are also met with. Rhabdi and spherasters, amongst other spicules, occur in the Tunicata; and some of the spicules of the Alcyonaria also are remarkably similar to some forms of sponge spicules.

Since it is clear that spicules of similar form occur in very different groups of organisms, and in both crystalline and colloidal material, it follows that an explanation of these forms must be independent of special peculiarities of the organism and of the crystalline or non-crystalline structure of the material; in the skeletal structures of the higher animals it would appear that pressure and tension are chiefly concerned in determining the particular form which each sclere or bone assumes, and were it possible to connect the special forms of spicules with the action of these forces, an explanation would be reached which would fulfil the conditions with which we started, *i.e.*, one independent of the nature of the material, and capable of being applied to all the organisms in which spicular forms are developed. Such an explanation is, I am firmly convinced, not only possible, but capable of being worked out in mathematical detail by any one who possesses the requisite mathematical power, but as I cannot pretend to this I can only hope in very meagre outline to suggest the nature of the explanation which I believe to be the true one. The principle of this is that all spicular structures tend to grow along lines of least resistance; if we can determine the law or laws which govern the distribution of these, we shall have furnished ourselves with the key which will unlock all the difficulties of the problem; at present we cannot hope to do more than offer approximations, other investigators no doubt will succeed in correcting and perfecting them.

The simplest form of spicule is a minute granule, generally more or less spherical; it is an indifferent form, which we need not stay to discuss; from it probably arises the sigmaspire, this forms a spiral line around the exterior of a scleroblast, having the form of a spheroid, sometimes prolate, but usually more or less oblate, especially when it lies near an epithelial surface of the sponge.

Finding a difficulty in explaining the origin of the sigmaspire on the lines laid down

[1] C. Stewart, *Trans. Linn. Soc. Lond.*, vol. xxv. pls. xlix., l. Hjalmar Théel, Zool. Chall. Exp., Holothurioidea, part xiii., 1882. R. Semon, *Mitth. a. d. Zool. Station Neapel*, Bd. vii. pls. ix., x.

on page lxxx for the triænes, I consulted my colleague Professor Fitzgerald, to whose kindness I am indebted for the following paragraph :—

"If a spicule grow anywhere on the inside of any closed surface, and if it grow chiefly in length, it will, as it becomes longer, press out against the surrounding surface and be forced into a line which will be a geodetic or shortest distance line on the surface, *i.e.*, the same line in which a stretched string *outside* the surface would lie. Now in a sphere such a line would be a part of a plane circle, but in any ellipsoid it would not, unless in very exceptional cases, be a plane curve at all, and in a prolate spheroid it would approximate to a spiral line. Hence when a substance deposits in long spicules inside a surface, or when it deposits in a split, which its deposition elongates within the thickness of a thin film—in either of these two cases it will form a geodetic. A geodetic has the following property, that the plane of any two consecutive elements is perpendicular to the surface on which the geodetic lies, and hence any tendency to deposit in the angle between neighbouring elements would give rise to a ridge perpendicular to the surface. If a growth be forcing its way within the thickness of a thin layer and in so doing splits the layer, it would naturally follow a geodetic. This is seen in the case of a split of a uniform glass ball and of a glass tube, such as a thin test-tube. In the former case the split generally follows a great circle, and in the latter it takes a spiral line, and these are geodetics on these two surfaces. It is plain that the splitting will naturally be perpendicular to the surface, for this is the thinnest direction in the surface, and if we consider an element splitting into a consecutive element, it is obvious from symmetry that the addition to the split will be in the plane of the first element, and of the perpendicular to the surface, *i.e.*, will be in continuation of the plane of the first element which is perpendicular to the surface, and so the split will follow a geodetic, and whatever is depositing in the split and forcing it to continue will deposit in a geodetic."

The growth of the sigmaspire along a geodetic which Professor Fitzgerald suggests is in exact accordance with the facts of observation, and if it be difficult to admit the existence of an actual split in the walls of the scleroblast, it will be probably found that a tendency to split will serve our purpose quite as well.

If the difference in the diameters of the ellipsoid be not very great the ordinary sigmaspire will result, if the growth of the polar diameter is much in excess of the equatorial a toxaspire, and eventually a spirula, will be produced, or the toxaspire may pass into a curved oxea.

The cymba or chela presents a case in which the deposition of opal has occurred along a meridian of a prolate scleroblast, and its ptera would appear to arise by a superficial deposition of silica consequent on an arrest in the general growth of the scleroblast. The position of the ptera is symmetrical, pointing to a symmetrical distribution of tensions in the surface of the scleroblast, and the falx is situated in the plane of the keel and median pteron, as it should be if these have formed along a geodetic.

The growth of a sclerioblast, either as a prolate or oblate ellipsoid, is determined by tensions existing in the organism, thus the oblate spheroids in the Tetillidæ are situated with the equator near a free surface and with their equatorial plane parallel to it; here the same surface tension which has given a pinacoid form to the epithelial cells has determined the oblateness of the spheroid; on the other hand, the toxaspires, which suggest a prolate form for the ellipsoid, occur only in the cortex in *Chrotella*, the spires of the chonemone in this sponge retaining the more usual sigmoid form. The cortex in this case exhibits the usual signs (tangentially directed fusiform cells) of tangential growth, which has in all probability led to an elongation of the sclerioblast in its own direction.

The spiraster, which must next engage our attention, offers much that is suggestive and much that is difficult of explanation. The spines proceed only from the outer side of the spire, and the inner side which partly surrounds the nucleus is smooth or devoid of spines; this is in correspondence with the general behaviour of the nucleus, and suggests that the region of deposition in the sclerioblast is as we have supposed situated near the surface: the production of spines, which may be regarded as due to radial tensions, at first suggests a difficulty, which can only be met by hypothesis; we have to suppose that the sclerioblast, at first growing in such a manner as to produce an oblate spheroid, as we should expect from its position near the epithelial surface, subsequently altered its rate of growth in different directions so as to enlarge in every direction at an approximately uniform rate; the spiraspire, thus becoming immersed in the sclerioblast, would grow outwards in a radial direction, and if the tensions were uniform a radial lamella might be expected to result; that the tensions should be uniform, however, is exceedingly unlikely, considering the general want of uniformity in nature, and thus instead of a continuous lamella a discontinuous one, or in other words a series of spines, results. We have here supposed the sclerioblast to continue to grow with a more or less spheroidal surface as it certainly does in the oxyaster, but it is possible that under the influence of tensions in the organism it may itself assume a prolate form; at any rate the spines once developed very soon betray the influence of such tensions, which lead to the transformation of the spicule first into the metaster, then into the plesiaster, and finally into the aster. Now it is a most important point, and one which we have already indicated, that in the Theneidæ in which this transformation can be traced through each successive stage, the passage from the round to the astral form is accompanied by an increase in size. This association I believe to be in the nature of cause and effect; for as the increase in size takes place the spicule is increasingly brought under the action of the tensions existing in the organism as distinct from those of the cell itself, now these tensions in a mass of mesenchyma must always be symmetrically distributed about any given point, and thus when the actions are definite in number we shall find them symmetrically disposed also: if two actions occur they should be directed along the same axis, and thus the preponderance of monaxons among the diactinate forms of aster results; if three are

present they should diverge from each other at three equal angles, or two at least should be equal, hence the preponderance of regular and sagittal microtriods amongst the triactinose asters; if four actines are present then they should make angles of 90° with each other or be directed as normals to the faces of a tetrahedron, and such we find to be the case; if six are present they might be variously arranged, but we should expect to find them frequently directed along three rectangular axes, as we so generally do. In certain cases, as amongst more or less closely adjacent spherical flagellated chambers, the tensions due to the presence of these spherical surfaces will be so directed as to distinctly favour the calthrops form, and thus in *Placina*, which possesses but little mesoderm, and in which consequently the chambers are crowded together, the calthrops is the prevailing form of microsclere. The Hexactinellids do not fall within the province of this Report and therefore will not be considered. While the asters of the Theneidæ clearly indicate the supersession of the influence of intracellular tensions by those of tissues or of the organism, there are asters in other families of which this cannot be said; thus the minute chiasters of the Stellettidæ, and other minute forms of both the Euastrosa and the Sterrastrosa, are only slightly affected by extracellular tensions, but as these pass into larger varieties the same influences are brought to bear as in the Theneidæ, and large asters with definitely directed actines as in that family result. The aster which attains the largest size of all microscleres is the sterraster; this commences in many of the Geodiidæ as a perfectly spherical sclere, with an infinite number of equal and similar actines of hair-like fineness, obviously developed under the action of radial tensions in a spheroidal scleroblast, which persists and can be observed up to the almost completed growth of the sclere; the circum-nuclear protoplasm is in this case inactive so far as the secretion of silica is concerned, and thus the position of the nucleus is always indicated by a hilum. The uniform growth of the sterraster along an infinite number of radii is to some extent perhaps connected with the abundant mesoderm which characterises the sponges in which it is produced, and to the fact that it completes its growth within the choanosome; but even in this spicule the influence of extracellular tensions is made manifest, for it is only the smaller forms which are almost perfectly spherical, in the larger the sclere is invariably ellipsoidal. Again in one group of the Sterrastrosa, the Erylina, the influence of the extrinsic tensions produces still further changes in the general form of the sclere, the actines in the equatorial plane being immensely over-developed compared with those in other directions, and thus a lenticular sterraster is produced; a still further change in form arises by the disproportionate growth of the actines along one of the equatorial axes, by which the lens becomes converted into a somewhat fusiform lozenge, which thus resembles a rhabdus in general form, while it retains the sterrastral structure. That this transformation is connected with lines of stress in the organism is suggested by the fact that the euasters are correspondingly modified, most of them suffering a reduction in the number of the actines, by which

they are converted into centrotylote microxeas. While a rhabdal form is thus produced in both sterraster and euaster, it is of interest to note in passing that the modification is accomplished in two different ways,—in the euaster by the reduction in the number of the actines, in the sterraster by a shortening in the length of those which in the euaster would be suppressed.

The chief forms of microscleres have now been discussed, and the megascleres may next engage our attention; these are clearly derivable from the microscleres by increased growth, and that such has been their origin there can in my mind be no doubt.

We have already seen that as the microscleres increase in size they become increasingly subject to the influence of strains in the organism, while the intracellular tensions become less and less effectual, on passing to the still larger megascleres we should naturally expect to find this tendency still more marked, as indeed we do; the tensions of the organism are in this case paramount, and the intracellular tensions may for the future be disregarded.

The tensions existing in the sponge as a whole offer such a complicated problem for study that we can only attempt to treat it in a most general way; it will, however, be clear that the growth of the sponge leading to an increase in surface and thickness may be regarded as taking place along radial lines and a superficial plane, the radial lines will furnish one direction of least resistance, the superficial plane others, the precise distribution of which will be considered when we come to treat of the triænes; for the present we may simply regard them as transverse to the radial lines of growth. The mode of growth of the choanosomal folds will be influenced by the relations between the increase of surface compared with the increase in thickness of the sponge, and thus some of the folds will increase radially and others transversely, concrescence between the longitudinal folds will give rise to radial tracts of mesoderm, between the transverse folds to transverse tracts, and along these tracts lines of least resistance will exist, probably lines of tension; their existence is indicated by the fusiform elongation of the collencytes when the tissue of the tracts, as is usually the case, consists of collenchyma. The direction of tension along any tract will probably undergo more or less change as it is traced from point to point, but the spicules are as a rule so short compared with the diameter of the sponge that in most cases, but not all, this may be disregarded, and the tension may be assumed for all practical purposes to act along a straight line. If now we take the case of the Tetillidæ in which the megascleres are supposed to have been derived from sigmaspires, and consider one of these spicules to undergo a vast increase of growth within the radial tracts of collenchyma, it will evidently be exposed to the action of a couple acting at its ends, and we should expect it to be elongated into a rhabdal form lying with its axis in the line of tension, *i.e.*, radially, and this is the position which, as a matter of fact, the spicules of these tracts invariably assume. The transverse tension has next to be satisfied, and in the lower forms of the Tetillidæ we find oxeas scattered transversely to the radial spicular fibres, which the radially directed

spicules by their accumulation produce. In the higher forms of the family the radial spicules alone are developed; for this I am not prepared with an explanation. In many of the Stellettidæ and the Geodiidæ the same absence of transversely disposed spicules is also a constant characteristic.

If instead of a sigmaspire we consider an aster situated in the interior of the sponge, and enlarging by growth into a megasclere, the results will be but slightly different, in some cases the radial tensions will lead to the overdevelopment of the two actines which lie in the line of growth and the remainder will be suppressed, so that an oxea will result; and in other cases some of the actines will be developed under the action of the transverse tensions, or rather of tensions which are the resultants of the transverse and radial tensions, the result of this might be the development of a triaxon spicule with six actines, or of a calthrops; in some sponges the triaxon and in others the calthrops is produced; in the Tetractinellida it is characteristically a calthrops, as on *á priori* grounds might have been expected. Thus in this case there are not two sets of oxeas, developed one along lines of transverse, and the other along lines of radial strain, as in the Tetillidæ, but the different actines of the same spicule are some directed radially and some transversely, as in the Pachastrellidæ.

The effect of the tangential strains at the surface of the sponge may be best considered by first studying the effects of a uniformly distributed strain on a thin pellicle which yields by fissuring. The fissures so produced are rectilinear and intersect either at right angles, producing a rectangular system of cracks, or at angles of 60° or 120°, producing a system of hexagons or equilateral triangles; the hexagons, since they present the smallest perimeter in relation to the area, are the most likely to result. Triradiate fissures thus produced have given rise to the hexagonal form of basaltic columns. The rectangular cracks are common in the glaze of "crackled" pottery. Though in the skin of the sponge actual fissures are not produced yet the lines along which they tend to be produced are lines of least resistance, and if spicules or the actines of spicules tend as we maintain to develop along such lines, we should expect to find them symmetrically arranged so as to form rectangular, hexagonal, or triangular areas, and on the principle of least action as already suggested, we should expect rather to find a hexagonal system than either of the others. And this or the triangular system is actually that which is most commonly met with in the dermal skeleton, not only in the Tetractinellida, but in the simpler Calcisponges, in the horny Sponges, the Monaxonida, and outside the Sponges altogether in the Radiolarian test (*Haliomma*, &c.), and in the spicules and skeletal network of the Echinodermata; the rectangular system occurs both in the Radiolaria and the Echinodermata, and in the Hexactinellid Sponges.

The application of these conclusions to the interpretation of the forms of sponge spicules is obvious; take the case of a rhabdus spicule growing under the influence of radial tensions within the interior of the sponge till it meets the skin; here it meets an

opposing surface, and in some cases becomes terminated by a tylus, as in the oxytylotes of *Esperia marshalli*, and as was probably the case with the ancestral form of triæne, since these spicules although they commence to develop a tylus while situated in the interior of the sponge do so possibly by precocity. If not, we may suppose that tangential strain in the interior of the sponge leads to a general terminal growth. As the tylus which we suppose to have formed immediately below the skin increases in size, it grows along three lines of least resistance inclined to each other at angles of 120°, and thus the triæne results.

Again, take the case of a simple calcareous sponge: let a scleroblast be situated near the surface of the sponge, as it must be in the Ascones; the surface tension will here also lead to the growth of three actines inclined at angles of 120° to each other, and thus the triradiate spicule so common in the calcareous sponges may have arisen.

Returning to the triæne, the growth of the cladi may continue in a straight line, or bifurcation may take place, and if it does the deuterocladi should, according to theory, make angles of 120° with each other and with the protocladus, or if not, the angles between the protocladus and each of its deuterocladi should be equal. Observation here supports theory, these conditions, one or other of them, being always fulfilled in the case of the dichotriænes.

Several matters of detail remain for discussion; in the first place the form of the protriænes in the Tetillidæ, and of the early forms of orthotriænes in the Stellettidæ and other Tetractinellida, cannot be lightly passed over. The last-named spicules at the time they appear in the choanosome being practically protriænes, are susceptible of the same explanation as seems inevitable in the case of these spicules in the Tetillidæ, *i.e.*, we must suppose that they were evolved under the actions of tensions which are the resultants of the radial and tangential tensions; given that the cladi lie in the direction of the resultant, and it is possible to determine the ratio between the radial and tangential forces which have determined their direction, for in a triangle of forces the length of the sagitta will represent the magnitude of the radial tension, and half the length of the chord that of the tangential tension; in a very young specimen of *Cranicella schmidtii*, still enclosed within the body of the parent, I find by measurement that the radial is to the tangential tension as three to two. In the Tetillidæ the protriæne retains its protriæne form throughout life, but in the Stellettidæ and Geodiidæ it subsequently passes into a plagio-, ortho-, or dicho-triæne. This change, in the case of young spicules developing in a fully grown sponge, takes place as they approach the outer epithelial surface, towards which they travel as they grow, and the tangential direction of the cladi is not fully assumed till they lie quite close beneath the skin or the floor of an intercortical cavity, where we may fairly assume that the tangential tensions are at a maximum. This change in the direction of the cladi is frequently very marked, especially in the case of the dichotriænes, in which the protocladi may be directed like

the cladi of a protriæne, while the deuterocladi are almost invariably tangential in position.

The anatriænes present a difficulty which is not readily overcome: this is the recurvature of the cladi. In the very young spicule they are extended from the tylus at right angles to the rhabdome, that is in an exactly tangential direction, but with growth they begin to curve backwards till they may become almost parallel to the rhabdome. Hitherto we have not been careful to distinguish between a line of least resistance due to direction of growth and one due to tension, for either would in most cases serve our purpose equally well, but they are evidently of different character, for a line of growth is to be represented by a vector, while a tension if represented vectorially must be drawn as two equal and opposite vectors; it is possible that this distinction may be of service to us here, for if the anatriæne be compared with the other forms of this triæne, it will be found that it is generally, I think always, distinguished by a longer and thinner rhabdome; this points to a relatively quicker growth in a radial direction, and owing to this the cladome of the spicule will encounter resistance as it is pushed forwards, if so the cladi, which from their inception point outwards at right angles to the rhabdome, will grow in backwards, as this is the direction of least resistance. Of course, there are difficulties in the way of this explanation, but a complete theory of spicules is not evolved all at once. One difficulty is involved in the often excessive length of the rhabdome, a character we have employed in our explanation, for it might fairly be argued from the line of reasoning here followed that this excessive length is itself a result of tension, and just what we should expect from the function of this spicule, which is partly to resist the pull of currents on the sponge when it lives anchored by these spicules in the ooze of the sea floor.

If therefore the rhabdome is produced by a *vis â fronté* acting at the cladal end, how can a *vis â tergo* be called in to account for the backward direction of the cladi?

As an interesting example of the influence of tension on spicules, we may refer to the appearance of accessory cladi, which now and then make their appearance in triæne spicules; thus beneath the cortex of some sponges are found large, somewhat spherical, cavities, which have already been alluded to as subcortical crypts, and it sometimes happens that spicules passing by the sides of the crypts develop a lateral spur, such as is shown in Pl. XLIII. fig. 19 at α. This is clearly due to the tension exerted by the membranè of the roof of the crypt on the adjacent tissue, a tension which was not sufficient to divert the rhabdome from its course, but was sufficient to elicit an accessory cladus, and this has just that direction it should have according to theory.

A curious point of detail represented in the figure just referred to may be noticed in passing; it is the total disconnection of the axial fibre of the accessory cladus and that of the rest of the spicule. I have observed one or two other instances of this, but they are not common.

ARRANGEMENT AND DISTRIBUTION OF THE SPICULES.

I. Microscleres.

In *Placina monolopha*, simplest of the Tetractinellida, microscleres of two orders of size present; the smaller are monolophous microcalthrops, and these are distributed immediately beneath the epithelial surface of the sponge, chiefly occurring beneath the epithelium of the outer skin; the larger are microcalthrops, microtriods, and microxeas, these are densely and uniformly distributed throughout the mesoderm, lying in contact with the flagellated chambers, to which their actines are tangential. A similar distribution occurs in *Epallax callocyathus* (*q. v.*, Appendix, p. 423, Pl. X. fig. 11).

In *Placina dilopha* the lophose actines are obliquely directed outwards towards the external surface of the sponge; in *Placina trilopha* the three lophose actines are directed towards the outer surface, so that this spicule is orientated like a trichotriæne, which it closely resembles; in *Thrombus challengeri* the trichotriænes are similarly directed when they lie near the exterior of the sponge, but in the choanosome they are dispersed without any approach to regularity.

In most of the Theneidæ microscleres of three orders of size are present, the smallest, spirasters or amphiasters, usually occur immediately beneath the epithelial surfaces, thus occupying a similar position to the smallest microscleres in *Placina* (occasionally they present forms suggestive of derivation from a lophose calthrops), those of intermediate size, the metasters, have much the same position; the largest (plesiasters, euasters, or microxeas) are however no longer related to the flagellated chambers, but rather to the walls of the canals, to which their actines most frequently are tangential (Pl. VII. fig. 2). In the remaining groups a relation between the orientation of the microsclere and the flagellated chambers is seldom to be traced.

With the differentiation of the sponge into ectosome and choanosome a differentiation of the microscleres is usually associated; thus in the Tetillid, *Chrotella macellata*, ectosomal are to be distinguished from choanosomal microscleres; in the Stellettidæ and Geodiidæ, however, the chief distinction is into somal and choanosomal; the microscleres which lie immediately beneath the epithelium of the cortex also occur throughout the choanosome, hence they are somal; though they have so much the appearance of distinguishing the ectosome that by a slip (*lapsus calami*) they may sometimes be referred to as ectosomal. On the other hand, in the large majority of the Euastrosa a special variety of microsclere is confined to the choanosome, and this will be termed choanosomal. Sometimes in addition a special form of microsclere occurs both in the cortex and choanosome, but is restricted to the region surrounding the subcortical crypts; these will be termed subcortical.

In the Sterrastrosa the characteristic sterraster is present in addition to somal, choanosomal, and subcortical asters; it occurs in all stages of development, scattered irregularly in the choanosome, but when adult it passes into the cortex, where it unites with its

fellows by fibrillar fusiform cells to form a special layer—the sterrastral layer of the cortex. Considering the large size of the sterraster and the important part it plays in contributing to the skeleton of the sponge the sterraster might claim to be classed among the megascleres.

II. Megascleres.

Two types of skeleton may be distinguished in the Tetractinellida, the radiate and the irregular. The irregular is met with in *Placinastrella copiosa*, F. E. S., the genus *Pœcillastra* and its allies, in the Pachastrellidæ, and the Lithistida; but in all cases, triænes, when present, lie near the surface of the sponge orientated as in the radiate type, *i.e.*, with the cladome tangential to the surface and the rhabdome directed radially inwards; this is the nearest approach to regularity found in this group. In the choanosome of the Pachastrellidæ and *Placinastrella* the calthrops are scattered without order, though sometimes the actines tend to lie tangentially to the walls of the canals; in some species of Pachastrellidæ long slender rhabdi are present, and these often run in fibre-like tracts, which near the surface of the sponge are directed at right angles to it; one actine of a calthrops also may frequently be observed directed in parallelism with the rhabdi of such fibres. In *Pœcillastra*, groups of oxeas arranged in parallelism and calthrops with one actine parallel to the oxeas form the greater part of the skeleton; the spicule "drift" takes two chief directions, one more or less parallel to the chief direction of growth, lying in a plane parallel to the face of the plate-like sponge and running more or less parallel to its lateral margins, and the other transverse to this, directed at right angles to the face of the wall.

In the Lithistida the general arrangement of the spicules recalls that of the Pachastrellidæ, but the calthrops of the Pachastrellidæ is replaced by its representative, the desma, and by the union of desmas a more or less rigid network results.

The radiate type is that which prevails in the Choristida: it occurs throughout the Tetillidæ and the genus *Thenea*, and in most of the Euastrosa and Sterrastrosa. In young sponges of this type the spicules lie in radial sheaves between the incurrent invaginations of the choanosome; the rhabdomes of the triænes extend from centre to circumference, as do the associated rhabdi, and the cladomes of the triænes extend immediately beneath the external epithelium.

As growth proceeds the spicules increase in length, but not rapidly enough to keep pace with the tracts of tissue in which they lie; fresh spicules therefore make their appearance at the centrifugal ends of those first formed, and thus the spicule sheaf becomes elongated into a spicular fibre; when the fibre remains short compared with the length of the spicules it will still be occasionally referred to a spicule sheaf. In the Tetillidæ the radial sheaves or fibres are in some species crossed more or less transversely by loosely scattered oxeas.

By the projection of the radial spicules beyond the surface of the sponge a general

hispidation may result, the hispidating spicules may or may not differ from those which are confined to the interior of the sponge, the latter will be spoken of as "somal" spicules when they are common to the whole sponge body, the former may be distinguished as hispidating spicules, a term commonly employed by Carter.

Over special areas the hispidation may become more pronounced, and to these areas it may be restricted; thus arise rooting spicules and fibres, basal fringes, fringes of the oscular margin, of the vestibules, and so forth.

Radical Spicules.—The sponge may be seated immediately on the surface of the sea-floor, and the rooting (radical) spicules descend directly into the underlying ooze, either separately or as continuations of the somal spicular fibres; they terminate either freely and separately (Fig. XIII., *a*), or in a densely tangled and matted accumulation, which serves as a basis of support and in size rivals the sponge itself (Fig. XIII., *b*).

On the other hand the sponge may be supported some distance above the ooze by the radical fibres which form slender pillars supporting the sponge above, and below

Fig. XIII.—Modes of attachment of Sponges to the sea-bottom. *a*, *Tetilla cupiocamus*, rooted by a mesh of spicules in the ooze; *b*, *Cinachyra barbata*, seated on a basal mass of tangled spicules; *c*, *Thenea wyvillii*, supported by stems of radical spicules terminating in a basal mass like that of *b*; *d*, *Tetilla casula*, supported by a parachute-like arrangement of radical spicules.

terminating as in the last-mentioned instance by splaying out and matting together into an almost solid tangle (Fig. XIII., *c*) (*Thenea wyvilli*, p. 74).

In one instance (*Tetilla casula*, Carter) the margin of the flat base of a hemispherical sponge is produced into a dense rigid fringe of radical spicules which extend outwards and downwards, giving a parachute-like form and support to the sponge (Fig. XIII., *d*).

Cloacal Spicules.—The oscular margin is frequently produced into a thin tube, the walls of which are traversed longitudinally by spicules arranged palisade fashion in a spicule fringe or tube (*Tetilla*, *Cinachyra*, *Thenea*). In two species among the Stellettidæ the oscular margin is produced into a remarkable cloacal tube provided with a special skeleton, an account of which will be found under the description of *Tribrachium schmidtii* (p. 154), and *Disyringa dissimilis* (p. 161). In some of the Stellettidæ (*Pilochrota*), minute oxeas occur fringing the oscular margin in the same

plane as that of the aperture, in these instances the oscular membrane is also extended in the plane of the oscule. In *Myriastra*, another of the Stellettidæ, the openings of the excurrent canals within the cloaca are sometimes hispidated by small oxeas (p. 117).

Spicules of the Incurrent Openings.—The margins of the pores, whether occurring on the outer surface of the sponge or in special vestibular recesses (*Cinachyra*) are in the Tetillidæ frequently hispidated by trichodal spicules, usually protriænes; the excurrent pores in the cloacas of *Cinachyra* are similarly hispidated.

In the genus *Thenea* the margins of the equatorial poriferous recesses are fringed with long spicules, which project outwards and downwards where they fringe the upper margin, and upwards and outwards from the lower margin; when the recesses are circumscribed, forming several oval areas, the spicular fringe becomes a tube; occasionally the upper fringe is united to the lower by a strong thread of fibrous tissue.

Modifications of the Radiate Type.—In some sponges, chiefly the Tetillidæ, the radial fibres are spirally twisted about one diameter of the sponge, usually the vertical; there is no constancy in the direction of the twist, the spiral being as often left as right handed (*vide* p. 25). This modification may be explained as resulting from a difference in the rate of growth of the choanosome or spicular tracts and the cortex. They would appear to be spiral curves of pressure.

Many sponges which possess a radiately arranged skeleton when young lose all traces of it or any other arrangement when they attain to larger growth; this is the case with *Pachymatisma* and probably with most sponges which are closely related to species with a radiate skeleton, but which are without it themselves; as instances may be cited *Caminus*, *Erylus*, and many others.

Cortical Spicules.—With the differentiation of the cortex there arises the possibility of a further differentiation of spicules; in the Tetillidæ cortical spicules occur in most corticate genera, in *Craniella* they are confined to the inner and fibrous layer of the cortex, which they traverse not quite radially but with an inclination a little on each side of a true radial; in *Cinachyra* they are more nearly radial in direction, but occur chiefly in the outer three-quarters of the cortex, which, however, is fibrous throughout; in *Chrotella* they lie chiefly tangentially in the cortex, but without any precise arrangement. In none of the remaining Choristida do cortical megascleres play so important a part as in the Tetillidæ, occasionally in the Stellettidæ and the Geodiidæ small cortical oxeas are present hispidating the outer surface of the sponge, though without contributing largely to its support as they do in the Tetillidæ. In the Geodiidæ, however, hispidating cortical spicules may sometimes be observed, which though of apparently slight importance in the economy of the sponge itself, are of great interest owing to the resemblance which they bear to certain small cladoxeas described by Ridley and Dendy as hispidating the cortex of a Suberite (*Proteleia sollasi*);[1] these are very minute

[1] Ridley and Dendy, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xviii. p. 152, pl. v.

anatriænes which arise within the cortex and proceed from it for a short distance beyond the surface precisely after the manner of the cladoxeas in *Proteleia*.

Methods of Attachment.—Some of the Tetractinellida are without attachment or free, but the greater number are in some way or other attached to the sea-floor; in many cases the sponge is incrusting (*Placina*, *Astropeplus*), in others it rises from an incrusting base (*Pœcillastra*, many Lithistids), in some it is attached by strong fibrous bands produced by an outgrowth from the cortex (*Pilochrota*), and even in the case of sponges which are practically free, similar processes are present and attach to the sponge numerous small stones and other foreign bodies. In most deep-sea Sponges the attachment is by means of radical spicules, variously adapted to this purpose as already described (Fig. XIII.). Some species are excavating (*Pilochrota? lactea*, Carter), and some are parasitic (an undescribed species of *Geodia* which occupies the oscular tubes of a species of *Ectyon*).[1]

Migration, Protrusion, and Extrusion of Spicules.—Observations on various sponges (*e.g.*, *Tetilla grandis*, p. 12; *Anthastra communis*, p. 144) show that the young triæne spicules originate within the choanosome at some little distance from the cortex, from which the cladome is the more remote as it is less advanced in growth. The cladome of the fully grown triæne on the other hand lies as a rule either within the cortex or beneath the floor of the subcortical crypts. Thus with the growth of the spicule, the cladome is carried from the interior towards the exterior of the sponge. This is no doubt partly due to the fact that the growth of the rhabdome is chiefly in the long direction; and the absence of triænes from all parts of the spicular fibres except their distal terminations may be explained as resulting from the close connection into which the cladome is brought with the cortex, so that the latter in its growth carries the former along with it.

It is, however, possible that in addition to the movement of the spicule by growth, another takes place by which it is gradually but bodily translated from the interior towards the exterior of the sponge; and only by some such process does it appear possible to explain the presence of sterrasters within the choanosome of the Sterrastrosa in all stages of development, while in the cortex none but those fully adult are met with.

Supposing this outward migration to occur, its continuance would lead to the protrusion of the distal end of the spicules, and thus the occurrence of hispidating rhabdi and triænes is to be explained.

With a further progress outwards the hispidating spicules would at length lose all connection with the sponge and fall out as deciduous spicules.

Since there is nothing to distinguish the deciduous spicules of a living sponge from those left behind by a dead one, it is not surprising that this process has hitherto been overlooked and indeed unsuspected; there are cases, however, in which, while the organic connection of the spicules with the sponge is dissolved, yet a more or less close association persists; thus in *Chrotella macellata* (p. 20) the toxaspires, which become

[1] Sollas, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. v. p. 408.

more crowded together towards the outer epithelium, are found immediately outside it embedded in foreign matter which encrusts the surface; in *Calthropella simplex* a small spheraster occurs, and this is found scattered amongst the spicules of a small sponge, *Astropeplus pulcher* (p. 453), which incrusts it.

In *Cinachyra barbata* again the radical anatriænes are extruded in such profusion that they remain entangled together, forming a dense basal mass which serves as a support; a similar case is met with in *Thenea wyvillii;* the most conclusive proof, however, is furnished by *Synops neptuni* (p. 227), a sponge richly traversed by epochets, most of which are completely filled—"stuffed" would best express it—with deciduous spicules evidently derived from the sponge itself; this will appear from the fact, first, that they are all of the same shape and dimensions as those constituting the skeleton of the sponge, no admixture occurring either of foreign spicules or of the sedimentary detritus of the sea floor; and next, because there is no conceivable way by which these spicules could have been introduced into the epochets, except by extrusion from the sponge itself. The sponge is as much as 40 cm. high, and no one would think of invoking currents to introduce a pure gathering of spicules from the sea floor into labyrinthine cavities 30 to 40 cm. above it.

General evidence might very well have led us to conclude that an extrication of spicules from the living sponge really occurs, but nothing less than direct observation of the actual process could have furnished such conclusive proof as that afforded by the preceding instance, and even direct observation, unless long continued, would not have given us so clear an idea of the surprisingly large quantity of spicules which are thus cast out.

That this process must have an important bearing on the question of the origin of flints is obvious, and some remarks under this head will be found on p. 280.

Source of the Silica in Flints.—Since sponges have furnished some, and indeed no inconsiderable portion of the silica of flints, it becomes of interest to determine in a few instances the quantity of silica present in a sponge as compared with its total bulk, and hence if possible to frame an estimate of the time that would be required for the formation of a bed of flints.

The first step is to determine the total bulk of the sponge, including all contained cavities; various methods were devised to accomplish this, all giving more or less concordant results, but the following was found to be the simplest and least inaccurate:—A spirit specimen was transferred from alcohol to distilled water which was repeatedly changed till all traces of alcohol were removed. It was then totally immersed by means of a wire cage in well-boiled water contained in a weighing bottle, and the bottle and its contents were weighed; the sponge was then removed in its wire cage, the cage returned to the bottle, and a second weighing gave by difference the weight of the sponge together with that of the water which filled its interstices and coated its surface; in the case of densely hirsute sponges, the results would from capillarity have been too high, such sponges were therefore somewhat differently treated; after removal from a beaker of

distilled water they were touched for an instant with a piece of blotting paper, introduced into a dry weighing bottle, and their weight obtained direct.

The sponge was next dried in the water oven and again weighed. The specific gravity of the dried sponge being taken as two—and this a very close approximation—one-half of the weight of the dried sponge was deducted from the first weighing, and the remainder represents the weight of a volume of water equal to that of the total volume of the sponge.

To determine the quantity of contained silica, the sponge was next boiled in strong nitric acid till all traces of organic matter were destroyed, and the spicules remaining were separated by filtration; after well washing they were transferred to a platinum crucible, and the ashes of the ignited filter-paper added; to eliminate water in combination they were then ignited, at first over a Bunsen, and finally with a Herapath. The weight of the ignited spicules gave the weight of silica present in the sponge.

Having obtained the weight of silica present in a given sponge of known volume, we proceed as follows:—The specific gravity of flint varies from 2·5 to 2·6; taking the higher number, if we multiply by it the number representing the volume of the sponge, we shall obtain the weight of a flint of equal size, and can then directly compare the quantity of silica furnished by the sponge to that which would be required for the formation of a flint equal to it in size; an example will make this clear.

Sponge taken—*Anthastra pyriformis*, Sollas.

Weight of the sponge full of water, 1·9203 grammes.
Weight of the sponge when dried, 0·788 gramme.

$$1{\cdot}9203-(0{\cdot}788\div 2)=1{\cdot}5263 \text{ grammes,}$$

which is the weight of a volume of water equal to that of the sponge. This multiplied by 2·6, the specific gravity of flint, gives 3·96838 grammes, the weight of a volume of flint equal to that of the sponge. The weight of the ignited spicules is 0·6658 gramme; and

$$0{\cdot}6658\div 3{\cdot}96838=16{\cdot}77 \text{ per cent.}$$

From this it appears that the specimen of *Anthastra pyriformis* examined contained 16·77 per cent. of the quantity of silica required to convert it into solid flint. Expressed as a common fraction this is about $\frac{1}{6}$th, so that it would require six equal and similar sponges to furnish sufficient silica for the conversion of one of them into flint.

In making use of the material at my disposal, I selected such sponges as possess spicules resembling those found associated with the flints of the Chalk, and in the following table the quantity of silica they were found to contain is expressed, as in the example just given, as a percentage of that required for the complete conversion of the sponge into flint.

Table showing the percentage of silica present in various species of sponges, the weight of a volume of flint equal to that of the sponge being taken as 100:—

Tethya maza, Selenka, . . .	7·4	
Cinachyra barbata, Sollas, . .	5·5	(mean of 3 determinations).
Anthastra communis, Sollas, . .	5·05	
„ *pyriformis*, Sollas, . .	16·77	
Pachastrella abyssi, O. Schmidt, .	3·9	(mean of 3 determinations).
Cydonium hirsutus, Sollas, . .	17·5	
„ *pachydermata*, Sollas, .	9·9	
Azorica pfeifferæ, Carter, . .	6·44	
Corallistes masoni, Bowerbank, . .	14·6	
Vetulina stalactites, O. Schmidt, . .	25	(taken from a skeleton).
Theonella swinhoei, Gray, . .	13·4	(taken from a skeleton).

The mean of these results is 12·22 per cent.

Since $100 \div 12{\cdot}2 = 8{\cdot}18$, we may say that it would, on an average, require 8·18 sponges to produce a flint of the size of one of them.

It is now possible to form a rough estimate of the time required to form the material of a bed of flints.

The experiments initiated by O. Schmidt, and carefully carried out, first in the Adriatic and afterwards in the Gulf of Florida, agree in showing that it takes from five to seven years (say an average of six years) for a bath-sponge to grow from a cutting about one cubic inch in size into a saleable sponge. Now the size of this is not very different from that of an average-sized flint nodule; and assuming that the rate of growth of siliceous sponges is not very different from that of bath-sponges, we arrive at the following result:—It requires six years for the growth of a sponge equal in size to a flint nodule, and 8·18 sponges to secrete the silica of such a flint; supposing therefore these sponges to grow one after another end on it will take $8{\cdot}18 \times 6 = 49{\cdot}08$ years to grow sufficient silica for the formation of an average-sized flint nodule, and it would require no longer time for the formation of a whole bed of such flints. No one, I imagine, would have supposed without these data that the material for a bed of flints could have accumulated within an interval which is considerably less than a man's average lifetime.

It is very probably true that the rate of growth of bath-sponges and siliceous sponges is not the same, but a number of considerations combine to show that if the siliceous grow less rapidly than the others, yet this may be compensated for in other ways; chief amongst which we must regard the constant elimination of spicules from the living sponge already alluded to; furthermore, the silica contributed by the swarms of young sponges set free every breeding season, most of which probably perish before reaching maturity, may count for something.

Although the preceding observations prove the adequacy of sponges to furnish the

silica of flint nodules, it by no means follows that other kinds of organisms have not assisted. Schulze notices the comparatively rich development of Hexactinellid Sponges in association with Diatomaceous ooze, and I have observed something similar in the case of the Tetractinellida. If the contribution of these organisms and of Radiolaria be taken into account, the time required for the formation of the material of a bed of flints may be still further shortened.

4. ONTOGENY.

Remarkably few instances of early developmental stages have been met with. In *Craniella schmidtii* (?) (p. 39, Pl. XLII. figs. 20, 21) and *Craniella simillima* (p. 33, Pl. II. figs. 18, 19; Pl. XL. fig. 5) planulæ and young sponges were observed within the parent. Very young sponges, evidently having only just completed their embryological development, were observed in the case of *Thenea schmidtii* (p. 69, Pl. VIII. fig. 22) and *Stelletta phrissens* (p. 152, Pl. XVI. figs. 15–20). In sponges not in the Challenger collection I have observed similar very young sponges in the case of *Dragmastra normani* and *Geodia barrettii*; the young examples of the latter furnish valuable evidence bearing on the mode of development of the cortex; this will be found recorded in the revision of the family Geodiidæ. Unfortunately no examples of young sponges were furnished by the Lithistida.

External Gemmation.—The only Tetractinellid genus in which external buds have been observed is *Thenea;* Vosmaer was the first to describe them in the case of *Thenea muricata*,[1] they also occur in *Thenea schmidtii* (p. 69, Pl. VIII. fig. 21). So long as the buds remain attached to the parent they do not present any structure by which their true nature can be recognised, and this, therefore, at present is a matter of inference, resting partly on analogy with the structure of the similar buds of *Tethya*. As the external buds of *Tethya* are not further generally alluded to in the Appendix on the Monaxonida a few words must be devoted to them here. They were first discovered by Mr. T. H. Stewart, and described by Bowerbank in *Tethya lyncurium*;[2] in the same sponge they were subsequently investigated by Dezsö,[3] and in an allied species, *Tethya maza* (p. 440), by Selenka;[4] in another also closely allied species, *Tethya seychellensis*, they are described by Perceval Wright;[5] similar buds have been described by Merejkowsky in the Suberite, *Rinalda arctica*.[6] In the Challenger collection they were met with in a new species, *Tethya japonica* (p. 430, Pl. XLIV. figs. 11–13), as well as in *Tethya seychellensis* (p. 427, Pl. XLIV. fig. 1), in neither of these instances was any

[1] *Bijdragen tot de Dierkunde*, vol. xii. p. 6, 1885.
[2] Mon. Brit. Spong., vol. i. p. 149, 1864.
[3] *Archiv f. mikrosk. Anat.*, Bd. xvi. p. 626, pls. xxx.–xxxiii., 1879.
[4] *Zeitschr. f. wiss. Zool.*, Bd. xxxiii., 1879.
[5] *Trans. Roy. Irish Acad.*, vol. xxviii., Science, No. 2, 1881.
[6] *Mem. Acad. Imp. d. Sci. St. Petersb.*, ser. 7, tom. xxvi. No. 7, p. 5, 1878.

difference observed between the structure of the bud and that of the cortex of the parent sponge; fig. 14, Pl. XLIV. represents a part of the tissue of one of the gemmules, and it would serve equally well for the outer part of the adult cortex. It is evident that there is room for fresh investigation of this subject. In a specimen of *Tethya lyncurium*, which I obtained at Roscoff, the young gemmæ still within the cortex of the parent were well displayed in thin slices of gold-chloride preparations, their position within the cortex is indicated in fig. 15, Pl. XLIII., and one of them more highly magnified by fig. 16 of the same plate.

5. CLASSIFICATION.

Position of the Sponges in the Animal Kingdom.

Before proceeding to classify the contents of the Tetractinellida, we must decide on its systematic value; this involves a decision on the value of the group Spongiæ, and in order to arrive at this, the closely connected question of the systematic position of the Sponges must be discussed.

On this question there is profound disagreement of opinion among spongologists, as will appear from the following summary account.

The Sponges are or have been regarded as—

Protozoa—By Carter, Kent, and the late James Clark.[1]

Occupying a position intermediate to Protozoa and Metazoa—By Balfour.

An independent phylum—By Bütschli and Sollas (Parazoa, Sollas).

Metazoa; within this group regarded as—

An independent phylum or *special division*—By Balfour, Sollas, Heider.

Cœlentera.—By Leuckart, Haeckel, Marshall, Poléjaeff, Schulze, von Lendenfeld, Ganin. Of those who hold this view, Schulze, Polejaeff, and Lendenfeld regard the Sponges as having branched off from the rest of the Cœlentera at a very early stage. Marshall (as at one time Anton Dohrn) regards them as degenerate Cœlentera, which, according to Marshall, at one time possessed tentacles, nematocysts, and mesenteric pouches.

That the Sponges cannot be regarded as Protozoa seems to have become a settled opinion, with which all the known facts are in agreement. The same can hardly be said of the view which regards them as degenerate Cœlentera, and which rests chiefly on the radiate symmetry presented by the canal-system in two or three species; till it can be shown that this symmetry in those cases in which it is definitely expressed is a primitive and not a secondarily acquired character, it cannot be credited with any special significance. As to its being primitive, all the facts so far as they are known to me are definitely opposed to such a view.

[1] *Amer. Journ. Sci. and Arts*, ser. 2, vol. xviii. p. 320, 1866.

If the Sponges are to be classed with the Metazoa (as so many spongologists appear to think they should) the question arises as to whether they should be included with the Cœlentera, as a class (Ganin), subtribe (Polejaeff), or phylum (von Lendenfeld), or whether they should form a group independent of the Cœlentera? Vosmaer argues in favour of the latter alternative, as I did myself, and on the same grounds as Vosmaer, in 1876,[1] when I represented the relations of the two groups thus :—

The Gastrula attaches itself by

The oral pole	The aboral pole
Spongiæ.	Cœlentera.

If to this character we add the presence of choanocytal cells, the role played by the mesoderm, and the invagination of the flagellated cells in the amphiblastula of the Calcarea (inversion of the germinal layers?), it would appear that quite enough distinctions exist, and of quite sufficient importance, to justify us in assigning the Sponges to a place outside the Cœlentera.

We next approach the question whether the Sponges are to be included in the Metazoa or distinguished as a special subkingdom (Parazoa). Lendenfeld has an easy method of solving this problem : all animals are divided into Protozoa and Metazoa, the Sponges are not Protozoa, therefore they must be Metazoa ; similarly the Metazoa are divided into Cœlomata and Cœlentera, the Sponges are not Cœlomata and must therefore be Cœlentera ; it is owing to the fact that this has been overlooked, more especially that the subdivision of the Metazoa has not been fully appreciated, that Bütschli and others have fallen into error. Now that Lendenfeld has pointed it out nothing can be clearer, and no one, as he remarks, "will raise any objection to the statement" "that the Sponges are evidently Metazoa and no doubt Cœlentera." Although perhaps after such a fundamental oversight Bütschli and I (for I err in good company) might be excused from discussing this subject further, I shall now proceed to show on what grounds I still maintain the existence of a separate subkingdom Parazoa. In the first place the Sponges are distinguished by the constant possession of collared flagellate cells ; these never fail, for no Sponge, notwithstanding the vast number which have been exhaustively studied, is known in which they become replaced by ciliated cells, like those which occur in the Cœlentera and Turbellaria. On the other hand no animal, not a Protozoon, and in particular no Cœlenterate nor Turbellarian, is known in which similar collared flagellate cells appear.

[1] This was soon after Carter's discovery that the larva of *Halichondria simulans* attaches itself by the "posterior" extremity (Carter, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xiv. p. 14, 1874). My view was printed in a Syllabus of Lectures on Biology, of which about 150 copies were distributed ; although not published at this time the same view was alluded to later in an Article on Spongiæ, Cassell's Natural History, p. 325, 1883.

In the next place the researches of Barrois, Kent, and Heider make it clear that the characteristic choanocytes appear in the larval Sponge at an early stage of development (in the blastula). In no larval forms of the Cœlentera or Turbellaria have similar cells been observed.

Further, while the Sponges are distinguished by the presence of choanocytes, the Cœlentera are equally distinguished by the possession of cells bearing nematocysts; I do not know whether any Cœlenterate has yet been described in which nematocysts are not present; it is true that these structures are also present in the Turbellaria, but that only points to a common ancestry for this group and the Cœlentera.

If we derive the Sponges and Cœlentera from a common Metazoic ancestor, the simplest hypothesis will lead us to regard this as possessing both choanocytes and nematocysts; as the two groups diverged, one might be supposed to lose the choanocytal character and the other the nematocysts. I do not deny that this is possible, but it seems to me that a simple and wider reaching explanation may be found.

It is generally admitted that it is to the Infusoria that we must look for the origin of the Metazoa; if now we turn to this we find already existing collared flagellate individuals having a remarkable similitude to the choanocytes of the Sponge, and ciliated individuals possessing nematocysts and resembling the ciliated nematocyst-bearing cells of the Cœlentera and Turbellaria. The genera in which trichocysts or nematocysts have been observed are *Epistylis* and *Bursaria* among the Ciliata, *Polycricos* among the Dinoflagellata, and in the Microsporidian division of the Sporozoa. The Choanoflagellata do not possess them. The genera just mentioned as possessing nematocysts are so related that there is no reason for supposing that the nematocysts have independently originated.

The conclusion to which so far I am led is, therefore, that the Sponges have their origin in the Choanoflagellata, and the Cœlentera in Ciliata furnished with nematocysts.

It may, of course, be suggested that if the Choanoflagellata have arisen from the Ciliata, then both Sponges and Cœlentera might have been produced somewhere about the point of transition, and it is quite conceivable that this might have been a point at which some large ciliate cell remained attached or in continuity with choanoflagellate cells to which it gave rise, and in this way we might attempt to explain the early distinction of the choanoflagellate cells from the large granular cells in the amphiblastula of the Calcarea (Megamastictora). It will be found on consideration, however, that this view presents serious difficulties.

For the purposes of this Report the Sponges will be regarded as the only phylum of the separate subkingdom Parazoa—

Subkingdom PARAZOA.

Heterocytal organisms in which the endoderm, in whole or in part, consists of choanocytes.

Phylum SPONGIÆ.

Parazoa possessing a paragastric cavity, which communicates with the surrounding medium by means of pores.

Subdivision of the Phylum into Classes.

The subdivision of the phylum which commends itself as the most natural is into two classes, the one containing the Sponges that are provided with calcareous spicules and the other those that are not. This broad distinction was first made by Gray,[1] who named the two groups Porifera calcarea and Porifera silicea; Vosmaer[2] was the first to recognise the justness of this arrangement, but rightly objecting that the term "Silicea" is misleading, and recognising the difficulty of finding any positive character by which the class could be known, proposed to substitute for it "Non-calcarea"; Poléjaeff,[3] in his luminous Report on the Challenger Calcarea, recognises the independence of the Calcarea as a class opposed to all other Sponges, but does not attempt to find a name for the latter. I have proposed[4] to name the non-calcareous Sponges Plethospongia, a term which is not open to the objection of disjointedness, but which does not express any definite meaning. The difficulty of finding a term which shall, in an epigram of a single word, designate the group, arises from the fact that, while the Plethospongia are an eminently natural class, yet the characters by which they are united together are not common to all the members, but change from family to family, so that their union is a linked one, and while the families at opposite ends of the chain appear to differ *toto cælo*, they are united together by a continuous series of intermediate forms. It is possible that this difficulty arises from the fact that in the consideration of the Plethospongia the skeletal structures have been too exclusively regarded, and our knowledge of the soft parts is not yet extensive enough to enable us, with anything like confidence, to make use of their characters in classification; yet there is one distinction which obtains at least very generally, if not universally, between the calcareous and non-

[1] Gray, *Proc. Zool. Soc. Lond.*, p. 502, 1887.

[2] Vosmaer, Report on the Sponges dredged by the "Willem Barents" in 1878 and 1879, *Nied. Arch. f. Zool.*, Suppl.-Bd. i., 1882.

[3] Poléjaeff, Report on the Calcarea, Zool. Chall. Exp., 1883, part xxiv. p. 22.

[4] Sollas, *Sci. Proc. Roy. Dubl. Soc.*, vol. v., N.S., p. 112, 1886; an abstract of this note appeared in 1885, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xvi. p. 395.

calcareous Sponges, and that as regards the most distinctively sponge-cells they possess, viz., the choanocytes. For, as Haeckel has shown, these are comparatively large in the Calcarea and small in the Plethospongiæ; I have proposed, therefore, to use this character, which is more fundamental than that derived from the spicules, as a means of classification, naming those Sponges which are provided with comparatively large choanocytes Megamastictora (*μαστίκτωρ*, ὁ, the scourger, a fanciful term for a flagellated cell or choanocyte), and those with comparatively small choanocytes Micromastictora.[1] The Megamastictora contain only a single subclass, the Calcarea, the Micromastictora are subdivided into three, the Hexactinellida, the Demospongiæ, and the Myxospongiæ. Lendenfeld,[2] agreeing that the Sponges are subdivisible into two groups, which he terms subclasses, proposes to follow Gray, naming one Calcarea, and the other Silicea.

The Megamastictora may be defined as Sponges in which the choanocytes are comparatively large, from 0·005 to 0·009 mm. in diameter, and in which the embryological development is marked by an amphiblastula stage. The Calcarea are Megamastictora possessing a skeleton of calcareous spicules.

The Micromastictora are Sponges in which the choanocytes are comparatively small, not exceeding 0·003 mm. in diameter, and the embryological development is characterised by a blastula or planula stage.

The subdivision of the Micromastictora is a subject on which there is general agreement among spongologists up to a certain point: thus it is generally admitted that the Hexactinellida form a very natural group, which may be sharply separated from the rest of the class; but a difference of opinion exists as to the most convenient mode of classifying the remainder, which constitutes by far the larger portion of the class; Vosmaer and Lendenfeld propose two orders—the Spiculispongiæ and Cornucospongiæ, according to Vosmaer, or the Chondrospongiæ and Cornucospongiæ, according to Lendenfeld.

Vosmaer's classification will be better understood by giving the following short abstract:—

Class I. Porifera non-calcarea (equivalent to our Micromastictora).

Order I. Hyalospongiæ (identical with the Hexactinellida: the term Hyalospongiæ is a synonym).

Order II. Spiculispongiæ. Skeleton rarely absent, when present consisting of independent spicules, which may be united by interlocking as in the Lithistida, or into a fibre by organic substance.

Suborder I. Lithistina (identical with our Lithistida).

[1] Sollas, *Zoological Record*, vol. xxii., Spongiæ, p. 13, 1886.

[2] Lendenfeld, *Proc. Zool. Soc. Lond.*, 1886, p. 573 (1887).

Suborder II. Tetractina (identical with our Choristida).

Suborder III. Oligosilicina (including as families the Chondrosidæ and Halisarcidæ).

Suborder IV. Pseudotetraxonia (a single family, the Tethyidæ).

Suborder V. Clavulina (including as families the Polymastidæ, Suberitidæ, and Clionidæ; the last provisional).

Order III. Cornucospongiæ. Skeleton consisting either of monaxon spicules cemented together by spongin, or only of spongin, which may or may not incorporate foreign bodies.

Suborder I. Halichondridæ (including the families Halichondridæ, Spongillidæ, Desmacidonidæ, and Ectyonidæ).

Suborder II. Ceratina (including the families Spongelidæ, Spongidæ, Aplysillidæ, and Darwinellidæ).

The line of separation between the Spiculispongiæ and the Cornucospongiæ would appear from this classification to be as marked or nearly so as that between them and the Hexactinellida.

Lendenfeld's classification is as follows:—

Subclass Silicea (equivalent to our Micromastictora).

Order I. Hexactinellida, O. Schmidt.

Order II. Chondrospongiæ, Lendenfeld. Mesogloea hard. Spicules tetraxon, monaxon, anaxon, or absent; generally corticate.

Order III. Cornucospongiæ, Vosmaer. Mesogloea soft. (The rest of the definition is similar to Vosmaer's.)

It will be seen that the character on which Vosmaer chiefly relies in distinguishing the two orders Spiculispongiæ and Cornucospongiæ is the presence of spongin in the latter and its absence in the former. This character is, however, by no means absolute, for spongin occurs in several Sponges of the order Spiculispongiæ; setting aside Monaxonid species of the order, in which it is nevertheless present, I need now only indicate the Lithistida, *e.g.*, *Theonella swinhoei*, and the Choristida, *e.g.*, *Pœcillastra* (*Normania*) *schulzii*, as possessing spongin which unites some of the spicules together. But even were this not the case the two groups so evidently pass into each other that it is difficult to understand how two investigators, so intimately acquainted with the species of both orders, should expect to be able to separate them thus sharply; any line drawn between them must be one of mere convenience, and consequently not of the same value as that between them and the Hexactinellida, nor indeed in any way comparable.

But, it may be enquired, what of the additional character alleged by Lendenfeld to be

distinctive? To this I answer frankly, that as a distinctive character it has absolutely no existence; the mesogloea (which, as a term, is preferable to the certainly objectionable mesoderm) is in some very few of the Chondrospongiæ a chondrenchyme, but in the vast majority it is a collenchyma (soft mesogloea) or sarcenchyme (also a soft mesogloea), the former precisely similar to the collenchyma, and the latter probably to the granular collenchyma of the so-called Cornucospongiæ; this presumed distinction is thus of far less value than that supposed by Vosmaer, for it is not even fairly general, while the absence of spongin in the Spiculispongiæ is. Nor, I regret to say, can I agree with Lendenfeld in regarding the so-called Chondrospongiæ as generally corticate; a large number certainly are, but a goodly number as certainly are not.

The Spiculispongiæ and the Cornucospongiæ cannot be distinguished, either by the characters of the skeleton or of the soft parts; they pass insensibly into each other, as Carter alleged long ago.[1]

It would therefore appear that a single order equivalent to the Hexactinellida should be defined to receive the other members of the class, and there would certainly be great convenience in this proceeding, were it not for the existence of the Myxospongiæ, Sponges without any skeleton at all. If it were possible to accept Vosmaer's view that these are simply degraded forms which have lost a skeleton they at one time possessed, one might readily include them in a single group with the rest of the Micromastictora that are not Hexactinellids, but for this presumed degradation there appears to me to be no shred of evidence; the Halisarcidæ are characterised by great simplicity, both in the chamber-system and in the canal-system; and in the course of their embryological development they give no signs of a retrogressive metamorphosis; they may therefore with much greater probability be regarded as persistent simple forms, descended from askeletal ancestors which were the common parents of them and the spicular Sponges. If this view be taken of the Halisarcidæ and their associates, it appears to follow that their position amongst the Sponges is so unique that they should be separated from the rest of the Micromastictora as a distinct order, and we then arrive at the following classification:—

Class I. Megamastictora (with the single subclass Calcarea).

Class II. Micromastictora.

Subclass I. Myxospongiæ. Micromastictora which are askeletose.

Subclass II. Hexactinellida. Micromastictora in which triaxon spicules contribute to the formation of the skeleton.

Subclass III. Demospongiæ.[2] Micromastictora which possess a skeleton either of siliceous spicules or spongin, or of both combined, but the megascleres are never triaxons.

[1] Carter, *Ann. and Mag. Nat. Hist.*, ser. 14, vol. xvi. p. 58 (sep. copy), 1875.

[2] Sollas, *Sci. Proc. Roy. Dubl. Soc.*, N.S., vol. v. p. 112, 1886.

The subdivision of the Demospongiæ may be made primarily into two tribes, the Tetractinellida and the Monaxonida, the latter including as orders the Monaxona, *i.e.*, Monaxonida in which a spicular skeleton is present, with or without spongin in addition; and the Ceratosa, which do not possess spicules, but only a spongin skeleton; since, however, the Ceratosa are evidently and admittedly directly descended[1] from the Monaxona, they are naturally included in the same tribe: though objections may be readily found to giving to this the name Monaxonida, its justification lies in the fact that it indicates the descent of the tribe, and further, that it stands in convenient opposition to the term Tetractinellida, by which the second tribe is designated.

The classification of the Tetractinellida will form the subject of a separate heading.

Classification of the Tetractinellida.

The Tetractinellida are Demospongiæ in which some or all of the scleres are tetraxons triænes, or desmas.

The name was first proposed in substantially the same sense as it is employed here by Marshall,[2] who expressly stated that he intended by it to include both Choristid and Lithistid Sponges, though he does not use these names.

It was subsequently adopted by Zittel,[3] but with an altered and restricted meaning, since it was made to apply to the Choristid Sponges only, the Lithistids being excluded, on the erroneous supposition that no very close connection could be shown to exist between the two groups.

The term was next accepted by myself,[4] its original sense being retained; this rendered necessary the subdivision of the group it denotes into two, which were named Choristida and Lithistida. Later[5] a more elaborate classification was proposed, which, though supported in its main outlines by the results of subsequent investigations, is here abandoned in favour of another.

Schmidt[6] also adopted the term, but in the restricted sense proposed by Zittel.

Vosmaer[7] also, but with a change of form to Tetractina; since the Tetractinellida of

[1] Sollas, Cassell's Natural History, Spongiæ, p. 328, 1881. I here give the exact words in which this view was first expressed:—"This family (*Chalinidæ*) indeed links together the Silicispongiæ and the Cerospongiæ, and since its spicules must apparently be formed before the spongin which envelopes them, it would appear rather that the Cerospongiæ were derived from the Silicispongiæ by loss of spicules, than the latter from the former by their acquisition." See also Vosmaer, *Mitth. a. d. Zool. Stat. Neapel*, p. 490, 1884; Schulze, *Abhandl. d. k. preuss. Akad. d. Wiss. Berlin*, p. 33, 1886; Lendenfeld, *Proc. Zool. Soc. Lond.*, p. 571, 1886 [1887].

[2] "..... der vereinten Lithistiden-Corticaten-gruppe, die den Namen der Tetractinelliden führen mag, ..." Marshall, *Zeitschr. f. wiss. Zool.*, Bd. xxvii. p. 134, 1876.

[3] Zittel, Zur Stammegeschichte der Spongien, Munich, 1879.

[4] Sollas, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vi. p. 386, 1880.

[5] Sollas, *op. cit.*, vol. ix. p. 164, 1882.

[6] O. Schmidt, Spong. Meerb. Mexico, p. 68, 1880.

[7] Bronn's Klass. u. Ord. d. Thierreichs, Porifera, p. 315, 1885.

Zittel are not the Tetractinellida of Marshall, this change in termination is both justifiable and convenient; Vosmaer's Tetractina is, however, anticipated by my Choristida.

The examination of the material brought home by the Challenger served to deepen my conviction of the close relationship of the Choristida and Lithistida, and since the researches of all other naturalists who have made a close study of these two groups have led them to similar views,[1] I shall retain both the name and the group first proposed by Marshall.

The Tetractinellida are not by any means all provided with tetractinose or even triæne spicules. Triæne spicules though present in many Lithistids are absent from more; and some sponges which may fairly be included in the Choristida (*Placospongia* for instance) are equally devoid of them, and also of tetractine spicules.

The triæne spicule also is far more characteristic of the group than the tetraxon, and thus it would be quite as appropriate to term it the Triænellida as the Tetractinellida. This, however, is not a matter of any importance, and as to the absence of triænes and tetraxons, such cases are remarkably rare in the Choristida; and though much more common in the Lithistida (whole families being without these spicules here), yet as the whole of this order is bound together by the constant presence of the desma, and since the ancestral forms from which all the others have descended are characterised by both triænes and tetraxons, or tetraxonid desmas, the term can be appropriately used, just as Monaxonida may for a group which includes Sponges (Ceratosa) without Monaxonid spicules.

There is one serious inconvenience attaching to the presence of Sponges in the Choristida which do not possess either triæne or tetraxon spicules, for these make it impossible to frame a short definition which shall include them along with the rest; they find no acknowledgment in the definition here adopted for the Tetractinellida, and my apology for this is two-fold; in the first place it is not absolutely certain, but only highly probable, that they are degenerate Tetractinellid forms, so that in including them in the group I have attached to them a query, and in the next place if they are truly immediately descended from the Tetractinellids, it may still, as a matter of convenience, be permitted to refer them to the Monaxonids, since they actually are Monaxonid, than to destroy the simplicity of our classification; their phylogenetic descent may be left to be indicated by genealogical trees.

These remarks open up the whole question as to the views which should guide us in framing a classification; at present it appears to be generally admitted that a system of classification should be founded rather with reference to the blood-relationships of organisms than to the mere sum of their resemblances and differences in structure. With regard to the higher forms of life there is everything to be said in favour of this view, the more especially since a strictly morphological and a phylogenetic classification

[1] O. Schmidt, Spong. Meerb. Mexico, p. 13, 1879; Döderlein, *Zeitschr. f. wiss. Zool.*, Bd. xl. p. 69, 1884.

will in their case be one and the same thing, but it is different in the more primitive groups, for here the resemblance of a group to a tree is unfortunately too apposite, since so many of the leaves borne by different branches are essentially similar to one another, *i.e.*, similar genera exist in the lower groups such as Sponges, which have nevertheless a different ancestry; thus the Monaxonids are evidently a highly polyphyletic order, some of them having arisen from near the root of the Demospongiæ, and others from its highest branches, and still others from intermediate points. And if we attempt to classify them according to descent we shall have to place in different groups genera which are structurally similar, and this would be equivalent to the method of a chemist who should attempt to classify a homologous series of compounds, not according to their structure, but according to the methods which he had employed to produce them. It may be urged that the similarity alleged is apparent merely, and I will not attempt to deny that this is probable; future investigations may reveal important differences at present not dreamt of, but till these are made clear, it would seem better to classify by the similarities we do perceive than by a supposed phylogeny that may be wholly illusory. It is possible that the concrescence of the choanocytes which occurs in all the higher Tetractinellids may eventually serve to distinguish them from the Monaxons proper. Those Monaxons which have descended from the various families of the Tetractinellida might then be included by some such definition as the following:—TETRACTINELLIDA, *Demospongiæ characterised by desmas, triænes, or tetraxons, and where these are absent by the concrescence of the choanocytes.*

But at present our knowledge of the minute characters of the Monaxons is not complete enough to enable us to judge of the value of this possibly distinctive character; in such Suberites as I have examined there is no concrescence and I hold this provisionally as completely separating this family from the Tetractinellids and as uniting it with the Monaxonids; so too there is no concrescence in the Tethyidæ, which must therefore also be assigned to the Monaxonids; on the other hand, in the purely Monaxonid Sponge *Amphius*, which on morphological grounds we conjecturally derive from the Stellettidæ, concrescence has been observed, and there would thus appear to be good reason for assigning it to the Tetractinellida as a degenerate or simplified form.[1] The characters of the choanocytes in *Placospongia* have not yet been made out, and thus although the presence of the sterraster in this Sponge would suggest its affinities with the Sterrastrosa, yet till we know whether the choanocytes are concrescent or not it may be as well to suspend judgment. For the present, therefore, I am content to use for the larger groups of Sponges names which are better defined by the contents of the group than by any form of words.

[1] There is no concrescence in *Placina*, and it is absent from species of *Tetilla*, but these are the simplest members of the order; the Suberites and Tethyidæ are Corticate Sponges and without concrescence, while all Corticate Tetractinellida present this character.

Order I. CHORISTIDA, Sollas.

History.—The first tendency towards a segregation of the Choristida from chaos appears in Oscar Schmidt's work on the Sponges of the Adriatic.[1] Here we find, together with one Monaxonid genus (*Tethya*), four genera of Choristida (*Stelletta*, *Caminus*, *Geodia*, and *Ancorina*), gathered together into a single family, the Corticatæ, and one more (*Corticium*) in another family—the Gummineæ.

In the third[2] supplement to this work Schmidt instituted another Choristid genus, *Pachastrella*, which, though placed in a third family, the Compaginatæ, is shown to be related to the Corticatæ and Gummineæ.

In his next work[3] Schmidt recognised that the cortex has not that value which he at first assigned to it, so that the family Corticatæ is there definitely abandoned, and all the Choristid Sponges there described appear in two families, the Ancorinidæ, which includes the following genera:—*Pachastrella*, *Sphinctrella*, *Tetilla*, *Craniella*, *Ancorina*, and *Stelletta*; and the Geodinidæ, which includes the following:—*Geodia*, *Pyritis*, *Caminus*, and *Placospongia*. Further the genus *Corticium* is removed from the Gummineæ and placed with the Sponges characterised by anchor-like spicules, a roundabout expression, as here used, for our Choristida.

In the system of the Sponges proposed by Carter[4] the Choristid Sponges are collected into two closely related families, in one of which, however, the Lithistida are also included; these are the Pachytragidæ, which contains our families Geodiidæ, Stellettidæ, and Tetillidæ; and the Pachastrellidæ, which contains our Lithistida and Pachastrellidæ. But for the association of the Lithistids too closely with the Pachastrellids this classification exhibits an advance upon Schmidt's, since the difference between the Geodiidæ and the Stellettidæ is not so wide as Schmidt's system implies, and these two families may well be grouped together; the recognition of the Tetillidæ as forming a group apart from the other members of Schmidt's Ancorinidæ is also justified by later observations; the inclusion of the Lithistids with the Pachastrellidæ, though going too far, errs in the right direction, for it correctly indicates that the Lithistids are more closely allied to the Pachastrellids than to any other Sponges.

Marshall having included the Sponges of Carter's two families into the single large group, Tetractinellida, the separation of the Choristids from this was made as already indicated by Sollas.

In his latest work[5] Schmidt definitely abandoned the Ancorinidæ and Geodiidæ as distinct families, and adopted the group Choristida, but under the name Tetractinellida.

The Choristida, by whatever name we know them, having thus become definitely

[1] O. Schmidt, Spong. Adriat. Meeres, pp. 37, 42, 43, 81, 87, 1862.
[2] O. Schmidt, Spong. d. Küste v. Algier, p. 40, 1868.
[3] O. Schmidt, Spong. Atlant. Gebiet., p. 64, 1870.
[4] Carter, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xvi., 1875.
[5] O. Schmidt, Spong. Meerb. Mexico, pt. ii. p. 68, 1880.

established as a natural group, our succeeding account will have reference to its subdivision into smaller groups; the first to attempt this was Vosmaer,[1] who proposed the following classification :—

Suborder Tetractina.

Family I. Geodiidæ (Genera—*Geodia*, *Isops*, *Synops*, *Pachymatisma*, *Cydonium*, *Caminus*).

Family II. Ancorinidæ (Genera—*Stelletta*, *Papyrula*, *Ecionema*, *Thenea*, *Dercitus*, *Agardiella*, *Sphinctrella*, *Ancorina*, *Tribrachion*, *Tethyopsis*, *Tricentrium*, *Ophiraphidites*, *? Craniella*, *Tetilla*).

Family III. Placinidæ (Genera—*Placina*, *Placortis*, *Placinastrella*).

Family IV. Corticidæ (Genus—*Corticium*).

The adoption of Schulze's family Placinidæ, and the addition of the Corticidæ, I recognise as necessary, but it is hard to see on what grounds Schmidt's two families, the Geodiidæ and Ancorinidæ, are retained, either both should have been merged into one, or the Ancorinidæ should have been broken up and its members redistributed; for the Geodiidæ, although they are conveniently regarded as a natural family, are distinguished from the Stellettidæ by a single character only, the possession of the sterraster, and these two groups are much more closely allied together than the members of the Ancorinidæ are to each other; but what makes the retention of this family all the more inexplicable is the fact that Carter[2] long ago recognised its unnatural character, and separated from it the Tetillidæ, Theneidæ, and Pachastrellidæ, as groups of equivalent value to the Geodiidæ. It is true that Carter did not call these groups families, but subfamilies, but this is a point of no consequence, any more than the fact that to the Tetillidæ Carter gave the name Tethyina.

In my preliminary account on the Challenger Tetractinellida I proposed a different arrangement[3] to that which is now adopted in this Report. The following is a short summary of that classification :—

Order I. Choristida.

Suborder I. Tetradina.—The characteristic spicules are calthrops, candelabra, amphitriænes, or modified triænes.

Family I. Placinidæ.—The chamber-system is eurypylous. Candelabra are present.

Family II. Pachastrellidæ.—The chamber-system is either eurypylous or aphodal. The spicules are simple calthrops.

[1] Vosmaer, Bronn's Klass. u. Ord. d. Thierreichs, Porifera.

[2] Carter, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xvi., 1875; ser. 5, vol. xi. p. 362, 1883.

[3] Sollas, *Sci. Proc. Roy. Dubl. Soc.*, N.S., vol. v. p. 177, 1886.

Family III. Corticidæ.—The chamber-system is aphodal. The spicules are candelabra, or amphitriænes, or trichotriænes, or triænes with a spinose surface.

Suborder II. Triænina.—The cladomes of the fully grown triænes are situated in the ectosome.

Family I. Tetillidæ.—The chamber-system is eurypylous or aphodal. The microscleres are sigmaspires or toxaspires. The form of the protriæne is characteristic.

Family II. Theneidæ.—The microsclere is a spiraster. The chamber-system is eurypylous.

Family III. Stellettidæ.—The characteristic microsclere is the aster. The chamber-system is aphodal.

Family IV. Geodinidæ.—The characteristic spicule is the sterraster. The chamber-system is aphodal.

The distinction between the Triænina and the Tetradina cannot very well be maintained, at all events without a redistribution of their contents; for the Tetradine family Pachastrellidæ is connected with the Triænina by the family Theneidæ; indeed, there is a most evident transition from *Thenea* to *Pachastrella* through the intermediate genus *Pacillastra* (*Normania*). If the suborders Triænina and Tetradina are to be retained, it can only be by transferring the Pachastrellidæ to the Triænina, and then the names for the suborders become inappropriate. And this was already the case owing to the presence of triænes in the Corticidæ. I therefore abandon these suborders, and now proceed to discuss the facts and principles which may lead us to a natural classification of the Choristida. We commence with a digression, for as in considering the best way to represent a tree, which of all natural objects best serves to represent the nature of zoological classification, we begin with the trunk and pass on to the branches and leaves, so in the present case we have commenced with the higher groups and are proceeding down to the lower; but this plan is not that of strict logic, and amongst its other inconveniences is that of the present digression, which it involves. And first we are met by the old time difficulty as to what constitutes a species. Is it a collection of similar individuals, separated from others by sexual sterility and the absence of intermediate forms? That it is a collection of similar individuals, united by the possession of similar characters and distinguished from others by the presence of common differences, we shall admit, but for my part I refuse altogether to have anything to say to the two additional limitations; good species may exist and yet be united on all sides by transitional forms, and as to mutual fertility, one would inquire how this test in the majority of cases is to be applied, and in the next, of what value in a morphological classification such a distinction is when it has been ascertained; it would

still have to be shown that mutual fertility in all cases served to define groups of equal morphological value; in fact, this test is a sort of last defence of the notion that species have, generally speaking, any other existence than the convenience of the describer.

The matter may be most readily considered by supposing that the systematist had before him for classification all the animals that have at any time existed; transitional forms between what are now accepted as the best of species would be as common as leaves in Val Ombrosa; yet classification would be as possible as ever, and not quite so uncertain as at present. But to a great extent the classification would be quantitative, and the groups resulting would have more equal value than those which, with our fragmentary material, we can now attempt to establish. Thus, with a continuous spectrum, in which all the tints pass insensibly into each other, the physicist is still able to speak of red and blue, though had he nothing else than the mere sense of colour to guide him he would have to agree upon conventional lines of demarcation; yet can any one assert that the results that would be so obtained would be less natural than such as would follow from a classification founded on a spectrum, produced by a prism with an absolute selective absorption for the very middle of the red, blue, and yellow regions? And how do we know that the interruptions in the series of animal forms produced by the action of natural selection are a whit more natural than that we have supposed in the illustration just suggested? According to Darwin it is the transitional forms which tend to become extinct under the action of natural selection; no doubt, but how are we to distinguish between transitional forms, where all are transitional at their inception. Is it not by the action of natural selection in causing them to become extinct? and is this not somewhat arguing in a circle? To me, therefore, a species is nothing more than a collection of more or less similar individuals, distinguished from other similar groups by any constant difference, however trivial, say in the details of form of a particular spicule, or by the relative size of the spicules in the two assemblages. It may be remarked that by the use of the qualification constant I revive that of the absence of intermediate forms under another form. But that is not really so, and the qualification might be omitted without affecting the definition, for if the character is not constant it might as well not exist. There is, however, in my mind a proviso that ought not to be unconsciously disregarded; this is the geographical distribution as an element in the definition of a species, and this evidently derives its value from the underlying belief in the doctrine of descent, for if the descendants of two originally similar parents, one of which had its home in the Pacific and the other in the Atlantic, do not differ from each other in any discoverable character, we have nothing for it but to class them together as a single species; should they, however, differ in the slightest definable particular, we shall readily make use of this to indicate the difference in their descent. Should now an exactly intermediate form be discovered in the Indian Ocean, this will not destroy the distinction between our two species, we

shall simply make a third of it, and if the localities are not so far removed, it will not make any difference to our procedure so long as the difference of habitat is, as supposed, associated with the difference in character. On this manner of viewing species, the different races of mankind would be regarded as species; and as very different species, much better defined than many species amongst the Invertebrates, I certainly would regard them; but to take a specific instance from the Sponges, in the Atlantic there is a group of similar forms of Lithistid which, without knowledge of any other similar group, we can with certainty call a species, and its differences from all other forms of Lithistid are sufficiently great to justify us in distinguishing it generically, it thus acquires the name *Siphonidium ramosum*; in the Challenger collection is a similar group of Lithistids, brought home from the Pacific, in outward form and general structure this is not distinguishable from the Atlantic group, one of its spicules, however, is different, being an oxystrongyle, while the corresponding spicule in *Siphonidium ramosum* is an oxytylote; had these Sponges been obtained from the same locality, they would have been placed in the same species (they differ far less than a Negro and a European), but coming from such distinct geographical regions I have placed the Pacific form in a new species—*Siphonidium capitatum*. With more hesitation I have distinguished the form of *Pachymatisma*, which occurs off the Norwegian coast, from that which is found in the English Channel, simply on a difference in the relative size of the spicules and in the thickness of the cortex.

The outcome of the preceding remarks would appear to be that assemblages of similar individuals, occurring in different distributional areas, may be regarded as species, if they present any constant difference of structure, however trivial.

We now pass to groups of genera, and the distinction between these will naturally be more marked than between species; generally there will be no difficulty in finding some clear and definite character by which one genus is readily separated from its nearest allies, but here again transitional forms cannot, as Nägeli, quoted by Poléjaeff, maintains, be regarded as destructive of the genera which they unite, for transitional forms on the evolutional hypothesis are as much to be expected between genera as between species. Thus from an origin a let two divergent lines ab ac be drawn to represent two groups of species evolved along different lines of descent and of the value of genera, then if the whole of the two series should be known to us it is plain that however divergent the two stems may be they must pass into each other at the origin a. Unless therefore nature exercises a selective destructive power specially at such points as a, we may frequently expect to find what are really good genera passing into each other as they receive fresh accessions of species. As to what constitutes a good genus, I see no escape from the admission, that as in the case of species it is a matter resting chiefly on the judgment of the describer, but there is one condition which should be satisfied as far as possible,—it should not, except in special cases, be founded on a

single character, but on an assemblage of characters; in this respect the genera of Tetillidæ are very excellent genera, but in several of the other families they are not so; thus I have separated the genus *Myriastra* from *Anthastra* among the Stellettidæ on account of the presence of two forms of aster in the latter, the former possessing only one, but this may possibly be justified by the great importance of the microsclere as a character in classification. The existence of a difference in the number of distinct kinds of spicules present in different species or the replacement of one distinct form of spicule by another, as an aster by a microrabd, frequently enables us in the absence of associated differences to group species together into assemblages, which are of great convenience, and which might perhaps be termed, as they have been by previous describers, subgenera; certainly if the presence or absence of spines over the surface of a spicule is a character of specific value, the absence of a distinct form of aster, or the substitution of a toxa or a microstrongyle for an aster, is of something more than specific value; whether we call it generic or subgeneric does not signify. Passing from genera to families it may be expected that here at all events we shall stipulate for the absence of intermediate forms as a condition to their separation; to this again I respond "No." So long as we admit the persistence of genera and species through long intervals of time, so long does it appear to me must we admit the possibility of transitional forms occurring between groups of all orders of rank, though, it need hardly be said, that the higher the rank of the group the less likely are such transitions to occur, and the more primitive the group, other things being equal, the less likely are they to occur, for the simple reason that divergence between the groups of higher rank and primitive forms took place at a much more ancient date than that between groups of lower rank and higher forms.

But we shall justly expect to find families defined rather by an assemblage of characters than by any single one, though naturally some single character will be more useful than others, and we find in the Sponges, as in so many other instances, that this is not usually the most physiologically important character, but rather the least so; owing possibly its preservation to this very fact, which has put it beyond, or almost beyond, the scope of selective influences.

Having formed our families on a consideration of the sum total of their differences and resemblances, we shall be in a position to judge of what are the most constant characters, and a knowledge of these will help us in the formation of higher groups, and in the investigation of the family relationships of other Sponges which are not so well known as the Tetractinellids. While the characters found to be constant in one group may thus serve as guides to the classification of another, they are merely guides, and so treacherous that they must be "followed with a loaded pistol at their heads"; in other words, a character, which may be constant enough in one family, may be a notorious example of variability in another. We shall now attempt to discover what are the most constant characters in the families of the Choristida.

There can be no question as to the validity of the family Tetillidæ, its members are united by a nexus of characters, one or another of which may disappear without any danger of the family character being lost.

The most persistent characters are the following :—the aggregation of the megascleres into radially directed fibres ; the form of the protriæne, anatriæne, and sigmaspire.

Oxeas are always present, but these spicules are too generally distributed to be of much service in classification ; they are so commonly anisoactinate in the Tetillidæ that in this particular they might be regarded as distinctive.

The cortex, once supposed to be of ordinal value, for Schmidt's families are equivalent to the orders of more modern spongologists, subsequently of subordinal value (Wyville Thomson), later of family value (Sollas), is now reduced to the distinguishing of genera, though in some cases it may define a family. In the Tetillidæ it is of generic value only.

The chamber-system may in other groups furnish characters for the definition of families, but not in the Tetillidæ, since the change from the eurypylous type to the aphodal takes place too gradually, the genus *Craniella* with its aphodal system being united to *Tetilla* with a eurypylous system through the intermediate genera, *Cinachyra* and *Chrotella* ; lest it may be objected that this remark is in opposition to those already made with reference to the possibility of intermediate forms existing between families, I would add that as a matter of convenience the subdivision of the Tetillidæ into two or more families has nothing to recommend it, for *Cinachyra* and *Chrotella*, while intermediate genera as regards the chamber system, are not intermediate but rather aberrant in other respects. Till our knowledge of the group is increased we must leave the aphodal and eurypylous Tetillidæ to form together one family.

The protriæne is highly characteristic and constant, but while it serves well to define the family, it is of no further use since it is not exactly repeated in any other group of sponges, or only very rarely.

The aggregation of the megascleres into radial fibres, chosen by Wyville Thomson as a character for the definition of an order—the Radiantia,—on which considerable stress has lately been laid by Vosmaer in the classification of the Monaxonida,[1] is of very doubtful importance ; in primitive forms, such as *Placina* and its immediate derivatives, it is wholly absent, the only approach to it being found in the orientation of the trilophous candelabras of *Placina trilopha*, which are directed near the surface in the manner of triænes ; throughout the whole of the Asterophora and the Sigmatophora the radial arrangement is prevalent, the most striking exception occurring in the family Pachastrellidæ, and even here in some genera the rhabdous spicules lie in bundles which tend to a radial direction. On the other hand, within the limits of a single family the radial arrangement may break down ; thus in the Theneidæ, which appears to be a very natural family, a perfectly radial arrangement characterises the genus *Thenea*, but none of the

[1] Vosmaer, Bronn's Klass. u. Ord. d. Thierreichs, Porifera, pp. 326, 328.

others, such as *Pœcillastra*, *Characella*, and *Sphinctrella*. So too in the Stellettidæ a radial arrangement is characteristic, but an exception is presented by the genus *Stryphnus*; in the Geodiidæ also the genera *Erylus*, *Caminus*, and *Pachymatisma* are non-radiate. In the Sigmatophora the arrangement of the spicules is best known in the family Tetillidæ; throughout this group it is radial, but in the lower forms, such as some of the species of *Tetilla*, the radial spicules are often crossed by numerous others concentrically arranged. From these examples, particularly that of the Thenceidæ, it would appear that the disposition of the spicules is a character which cannot be relied on for family distinctions.

Finally, as regards the sigmaspire, this is the most constant next to the protriæne with regard to form, but it is one of the least constant as to occurrence; it, or some obvious modification of it, is always present when microscleres are present at all; it may pass into a microstrongyle by straightening out and increasing in size, but in the only species in which this modification occurs the normal sigmaspire is present as well; it may also develop an additional half-turn and pass into a toxaspire, the normal sigmaspire in this case also persisting along with its modification; or finally it may become sparsely spined and thus approach the spiraster, but it is never replaced by a true aster. Thus, when present, the sigmaspire is characteristic; on the other hand it may fail altogether, so that allied species otherwise precisely similar may differ solely by the presence or absence of the sigmaspire,[1] *e.g.*, *Craniella cranium*, in which it is present, and *Craniella zetlandica*, in which it is absent. So similar in all other respects are these two species that but for the absence of sigmaspires in the one they could not be distinguished; and I should have been inclined to regard the absence of the sigmaspire as accidental, were it not that the young sponges, while still within the body of the parent, present the same difference as the adults, a fact first stated by Carter, and for which I can vouch, having seen Mr. Carter's specimens.

Now, while the occasional absence of the sigmaspire diminishes its value, in so far that it proves to be a guide which may at a pinch desert us, it does not by any means impeach its trustworthiness when present, and if we attempt to follow it in other groups of Sponges which are not Tetractinellids (see Appendix II. p. 413) we shall have to bear in mind that in the Tetillidæ it is not so much its absence but its truthfulness when present that is of importance.

The first application of this result was made in the case of the genus *Samus*, Gray; before I had seen a specimen of this Sponge its systematic position was to me most perplexing, but directly its spicules were before me I recognised at once the characteristic sigmaspire, and my thoughts naturally reverted to the Tetillidæ; clearly, however, *Samus* cannot be placed in this family, it differs in the absence of oxeas, of

[1] Does this suggest that the sigmaspire is the final and waning term of a degenerating series of microscleres, commencing with an aster and proceeding downwards through the spiraster? It would be surprising were this so, considering the other characters of the Tetillidæ.

spicular fibres, and in possessing as its only megasclere an exceptional form of spicule, the amphitriæne, which so far as I knew at the time does not occur in any other group of Sponges; while, however, I was debating as to the amount of trust to be reposed in the presence of the sigmaspire, I received from Mr. Carter a fragment of a new species of *Tetilla* (*Tetilla stipitata*, Carter) in which an irregular form of amphitriæne is present, and thus the suggested alliance to the Tetillidæ was confirmed. I now associate the Tetillidæ and the Samidæ (a new family of which *Samus* is the only representative) as a suborder, the Sigmatophora. Outside the Sigmatophora the sigmaspire is not met with in any group of Choristida, but it occurs in the Lithistida, and will be referred to again in the account of that order (p. 316).

The next family of the Choristida is the Theneidæ, which like the Tetillidæ appears to be a very natural one, the chamber-system is eurypylous, and the mesoderm collenchymatous throughout, the megascleres are oxeas and triænes in one genus (*Thenea*), and oxeas, triænes, and calthrops in another (*Pacillastra*); in *Thenea* these spicules are arranged in radial fibres, but in *Pacillastra* they form irregular tracts, and the calthrops are associated with the spicules of the interior, *i.e.*, in addition to triænes situated with their cladomes in the ectosome there are calthrops mingled with the oxeas of the choanosome, and that as far from the ectosome as the very middle of the Sponge. Notwithstanding this important difference, which would have removed *Pacillastra* from the Triænina to the Tetradina, when these groups existed, had their definition been rigidly adhered to,—notwithstanding this, we find that the microscleres are remarkably similar, and so much so as to make any wide separation of the two genera impossible, for not only is the characteristic spiraster present in both, but the equivalent groups of microscleres also; thus in *Thenea*, in addition to the spiraster, which may be modified into the very similar amphiaster, there are usually present metasters, and either plesiasters or euasters, and with the latter as varietal modifications may be associated microxeas; in *Pacillastra*, in addition to the spiraster, which in the closely allied genus *Characella* is represented by an amphiaster, there is usually present a metaster, sometimes plesiasters, and always and most abundant microxeas, which represent the euaster or plesiaster of *Thenea*. In *Sphinctrella* a similar association of microscleres occurs, and we may sum up the distribution of the microscleres in the Theneidæ in the statement that the spiraster is present in all species or represented by the amphiaster; metasters are generally present; plesiasters or euasters are present in all species of *Thenea*, but in the remaining genera of the family are represented by microxeas, *i.e.*, diactinose asters. Having found that the characters of the spiraster are as constant in the Theneidæ as those of the sigmaspire in the Tetillidæ, and that it possesses the additional recommendation of constancy in presence as well as in form, we shall look upon it as a very promising guide, still, however, to be followed by caution; thus in several genera which I have placed in the Euastrosa—*Stryphnus* for example—amphiasters occur, but these are of

such irregular form that they may be of different origin to those of the Theneidæ, and so for the present I leave the genus with what appear to be its more natural associates.

As an instance of the application of the character, I may select the new genus *Triptolemus*, first known to me, like *Samus*, by a single exceptional form of spicule, the centrotriaene, which is confined to this genus; a slide showing all the spicules, however, was given me by Mr. Carter, and the presence of microxeas and spirasters showed at once its relationship, which appears natural enough directly it is pointed out.

The family Pachastrellidæ which will next engage our attention is of great interest in this inquiry. The typical species, *Pachastrella abyssi*, like all the species of the family, is characterised by a sarcenchymatous mesoderm, aphodal chamber-system, and choanosomal calthrops; in the two former characters it differs from the Theneidæ, in the latter it resembles the Theneid genus *Pœcillastra*, but its resemblance to *Pœcillastra* is still further increased by the complement of microscleres, for these are spirasters, microxeas, and microstrongyles, all but the last named being evidently correspondent to those of *Pœcillastra*, while the microstrongyle is readily explicable as a reduced aster. *Pachastrella abyssi* may be regarded as a *Pœcillastra* which has attained a higher plane as regards the chamber-system and the mesoderm, and in which some of the microxeas have become shortened into microstrongyles. If now we pass to the other genera of Pachastrellids we shall find our caution as to the treacherous nature of single characters is no libel; so far as the spicules are concerned the only constant form is the calthrops; the microscleres vary unintelligibly, spirasters may be replaced by euasters (*Calthropella*), the microxeas disappearing, or instead of any astrose form, toxas and microrabds may be present (*Dercitus*), and in this genus the oxea of the megascleres also vanishes. With these wide differences to explain, we may suppose (1) that great variation occurred within the group after its separation from the Theneidæ, or (2) that it is of polyphyletic origin, *i.e.*, not a natural family; if we trust to the characters of the mesoderm, of the chamber-system, and to the presence of the calthrops, we shall incline to the first alternative, if to the microscleres to the second; I am myself in favour of the first, the strongest objection to it being furnished by the microscleres of *Dercitus*, for as regards the aster of *Calthropella*, that may well be derived from a spiraster, but the toxa and spinose microrabds of *Dercitus* are less readily explained, and instead of speculating upon them, it may be as well to wait for information as to their embryological development, which ought not to be difficult to study in the case of a not very uncommon British Sponge. That they do not offer an insuperable objection, however, I feel convinced, since there are several possible ways in which the microscleres of *Pachastrella abyssi* may have produced them.

Considering the two families—Theneidæ and Pachastrellidæ—together, we conclude that the spiraster is present in most of their genera, they may therefore be united as a

group, under the name Streptastrosa; they also are still more generally characterised by an aster of some form, whether spiraster, or euaster, or spheraster (*Calthropella*).

The Stellettidæ are a compact and natural family, the megascleres are usually radiately arranged, and an ectosomal triæne, which may be an orthotriæne, plagiotriæne, or dichotriæne, is invariably present, the mesoderm of the choanosome is without exception sarcenchymatous, and the chamber-system aphodal; these characters alone suffice to define it from the Sigmatophora and the Streptastrosa; the family is therefore one of particular value in an inquiry into the value of the microsclere in classification. We notice then in the first place that a euaster is present in every species of the family, and while in many genera an additional microsclere is present, this is never a sigmaspire, nor a spiraster, but either a second form of euaster, or a diactinose aster (microrabd) or a sanidaster, (*i.e.*, a chiaster with a rhabdal axis instead of a centrum), or an irregular amphiaster, which is similar to a sanidaster, but of uncertain origin.

The sanidaster and irregular amphiaster are the only microscleres in the family which are not centrastrose, and the amphiaster is the only elongated aster occurring in other groups, but even it presents differences which distinguish it from the amphiaster of the Streptastrosa, and more nearly resembles a sanidaster. The microscleres of the Stellettidæ thus adhere with marked persistency to the euastral type, yet not so closely as to render them infallible guides, for were a *Thenea* with amphiasters and euasters to acquire a sarcenchymatous mesoderm and aphodal chamber-system, one would feel bound to include it in the Stellettidæ. The nearest approach to such a complement of spicules as that suggested occurs in *Thenea delicata*, which possesses amphiasters and plesiasters.

The Stellettidæ, so far as we know at present, are the only family of the demus Euastrosa, but there are certain Monaxonid Sponges which may eventually have to be included; these have been placed in a family Epipolasidæ, as an Appendix to the Euastrosa; the character of the mesoderm and of the chamber-system is not known in those genera of the family which in their spiculation make the nearest approach to the Stellettidæ, *e.g.*, *Asteropus* (*Stellettinopsis*, Carter), which possesses oxyasters and sanidasters; in the only example (*Amphius huxleyi*), in which the chamber-system is known it agrees with that of the Stellettidæ, but this species possesses only one form of microsclere and that an amphiaster. The Epipolasidæ are not only without triænes, but the oxeas do not strictly adhere to a radial arrangement. There is another genus of the family which departs still further from the Stellettid type (*Coppatias*), and which I think should most probably be included with the Monaxonida, but as I have not had spirit specimens of these Sponges to examine I leave the question open.

The next family is the Geodiidæ, a very homogeneous group, characterised by the presence of the sterraster, but the constancy with which this spicule is present is of no service in the present inquiry, for were it absent the Sponge would become a Stellettid,

not to be distinguished from a species of *Stelletta*. But there is another family, also possessing sterrasters, the Placospongidæ, which differs widely from the Geodiidæ, partly in the character of the external openings of the canal-system, and still more in the total absence of triæne or tetraxon spicules; the sterraster, however, is such a highly peculiar form, known in no other group outside the Geodiidæ, that its presence in this case may be taken as allying the Placospongidæ with the Geodiidæ; for the two families thus united we find the common name Sterrastrosa.

The Sterrastrosa, Euastrosa, and Streptastrosa are all united together by the common possession of some form of aster, and, as a rule, they possess as well a second distinctive aster, they may, therefore, be united together in a single order, the Astrophora, as opposed to the Sigmatophora.

The remaining families are the Placinidæ, Corticidæ, and Thrombidæ; in all three there is an entire absence of megascleres, and in the first two the microscleres are variously modified tetractinose asters, in the last the microsclere resembles a minute triæne, and in one of its species is accompanied by a still smaller microsclere, which bears much the same relation to the larger form that the microscleres in the Astrophora and Sigmatophora do to the megascleres; this second form of microsclere, which is one of the minutest of all known spicules, is an amphiaster, the straight, slender axis being terminated by four minute recurved spines at each end; its form is quite peculiar and its origin obscure, so that it throws no light on the relationship of the family; as microscleres of only one order are present in the other two families, they will not help us much in an investigation into the relative constancy of characters, but it may be pointed out that, while the Corticidæ differ from the Placinidæ widely so far as the character of the mesoderm and type of chamber-system are concerned, they are evidently closely united together by the characters of the spicules, which in this case as in others are found to be more persistent than those of the soft parts. The character by which all three families are united into a single group is the presence in all of small spicules, which are all derivable from a tetractinose aster; thus in the Placinidæ the aster may assume the character of a candelabrum or of a triæne, the triæne in one species, *Placina trilopha*, resembling that of the Thrombidæ, except that it is not spinose; in the Corticidæ the candelabrum has been preserved as the characteristic form, in the Thrombidæ the triæne. In none of these Sponges do the spicules occur aggregated into fibres, and while the Placinidæ are evidently a primitive group from which the other two have been derived, these last agree together in possessing a diplodal chamber-system and a collenchymatous mesoderm; the three families may, therefore, be classed together as a single group, forming a third suborder, the Microsclerophora.

In searching for relatively constant characters we have been able to unfold at the same time the nature of our classification, and we have arrived at the result that such a phenomenon as an absolutely constant character does not exist; Sponges like other

organisms are each to be regarded as a nexus of more or less dependent variables; all change together, but at different rates; but amongst the less dependent are the microscleres, which thus maintain a relative constancy amidst the shifting changes of the rest. To the same conclusion Schulze appears to have been led, since in his already published system of the Hexactinellida, the systematic importance of the microsclere stands next in order to the Lyssacine or Dictyonine character of the main skeleton; just as in our classification it follows on the Lithistid or Choristid character. The same result will I expect be attained in the case of Monaxonida, when this large group has been more exhaustively studied. That this expectation is founded on something more than analogy will appear from some remarks (*vide* Appendix II.) on those Monaxonid Sponges which my colleagues, Messrs. Ridley and Dendy, transferred to me for examination on the supposition that they belonged to the Tetractinellida, a supposition which we shared together, and which was strengthened by the apparent absence of any close affinities between these Sponges and the rest of the Monaxonida with which my colleagues were familiar.

It will probably conduce to clearness if I give here an abstract of the classification of the Choristida so far arrived at, omitting the definitions, which will be given later:—

Order I. CHORISTIDA.

Suborder I. SIGMATOPHORA.

Family I. Tetillidæ. Family II. Samidæ.

Suborder II. ASTROPHORA.

Demus A. Streptastrosa.

Family I. Theneidæ. Family II. Pachastrellidæ.

Demus B. Euastrosa.

Family I. Stellettidæ. Appendix—Epipolasidæ?

Demus C. Sterrastrosa.

Family I. Geodiidæ. Family II. Placospongidæ.

Suborder III. MICROSCLEROPHORA.

Family I. Placinidæ. Family II. Corticidæ. Family III. Thrombidæ.

In order to arrive at more general results first, we shall postpone a consideration of the families of the Choristida till we have passed in review the Lithistida.

Order II. LITHISTIDA, O. Schmidt.

Historical.—The earliest description of a recent Lithistid sponge, *Macandrewia azorica*, we owe to Gray, who was not unnaturally greatly puzzled as to its nature; struck by the resemblance of its oscules to the calyces of an Alcyonarian, he was much inclined to place it with the Alcyonaria, but cautiously refrained from actually doing so, since he was unable to find any traces of the polypes.[1] Bowerbank would seem to have been the first to definitely include the Lithistida with the Sponges,[2] but he did not distinguish them from the Hexactinellida, and this, and his failure to understand the true nature of the skeleton either in the Hexactinellida or the Lithistida, led him into numerous errors; not only did he class together these two widely different groups in the same suborder, the fibro-siliceous Sponges, but he placed species belonging to both in the same genus; thus the genus *Dactylocalyx*, instituted by Stutchbury to contain the Hexactinellid species *Dactylocalyx pumiceus*, must be carefully distinguished from the genus *Dactylocalyx* of Bowerbank, which in addition to this species contained several others which are genuine Lithistids. This fact was not recognised by succeeding writers for some years, and thus we find Gray in his classification of the Sponges[3] including both Hexactinellid and Lithistid Sponges in his order Coralliospongia, and adopting the Bowerbankian genus *Dactylocalyx*, with its heterogeneous mixture of species belonging to two groups of different subclasses. Similarly Wyville Thomson, in an account of the Vitrea, an order proposed by him, falls into the same error.[4]

Duchassaing and Michelotti in 1864 instituted a family Lithospongiæ, but from its definition it might include Hexactinellid as well as Lithistid Sponges, and from the illustration given of the only species of the group known to them, I am inclined to think that it was actually based on a Hexactinellid Sponge.[5]

In 1869 Bowerbank[6] largely added to our knowledge of the species of the order, but included them all but one in the genus *Dactylocalyx;* in the same year[7] Bocage rescued one species from this omnivorous genus, to which he tells us Bowerbank had intended to devote it (as indeed he did in the Memoir just referred to, which was published slightly later than Bocage's description). This species was made the type of a new genus, *Discodermia*, under the name of *Discodermia polydiscus.*

The next great step in advance was made by O. Schmidt,[8] who brought the Lithistid

[1] Gray, *Proc. Zool. Soc. Lond.*, p. 437, pl. xv., 1859.
[2] Bowerbank, *Phil. Trans.*, p. 279, 1858.
[3] Gray, *Proc. Zool. Soc. Lond.*, p. 472, 1867.
[4] Wyville Thomson, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. i. p. 119, 1868.
[5] Duchassaing and Michelotti, Spongiares d. l. Mer Caraibe, p. 64, pl. xii. figs. 3, 4, 1864.
[6] Bowerbank, *Proc. Zool. Soc. Lond.*, p. 66, 1869.
[7] Bocage, *Jorn. Sci. math. phys. e nat. Lisboa*, vol. ii. p. 160, pl. xi. fig. 1, 1869.
[8] O. Schmidt, Spong. Atlant. Gebiet., p. 21, pl. iii., 1870.

Sponges together into a single order with the name Lithistidæ. The task of defining the characters of this order Schmidt left to others, and it was most ably accomplished by Carter,[1] who first furnished an exact account of the essential structure of the skeleton as it is presented in this group. Subsequently the same author made several important generic distinctions among the Lithistida.[2]

Zittel then followed with his great work on the order,[3] in which he subdivides it into four families:—the Tetracladina, Rhizomorina, Megamorina, and Anomocladina; this was a great step in advance, and has simplified the labours of subsequent writers, who have all adopted Zittel's system *en bloc*, excepting Carter, and Schmidt, the latter of whom has offered some important criticisms upon it.

The Tetracladina are distinguished by Zittel as possessing desmas with a quadriradiate axial canal; in the Megamorina and Rhizomorina the desmas exhibit only a uniaxial canal, and in the Anomocladina there is no canal at all, the tetraradiate or elongate axes of the desma in other families being here replaced by a massive centrum.

The characters of the families are given by Zittel as follows:—

Family I. Rhizomorina.—Desmas irregularly branched, beset with shorter or longer, simple or composite, root-like processes or nodular excrescences, with a simple or branched axial canal. Ectosomal spicules like those of the rest of the skeleton; rhabdi and dichotriænes also present.

Family II. Megamorina.—Desmas large, elongate, smooth, curved, irregularly branched, or only forked at the ends, with a simple axial canal, loosely interlocked with each other. Among them sometimes smaller desmas of Rhizomorine type. Ectosomal spicules rhabdi or dichotriænes.

Family III. Anomocladina.—Desmas consisting of four or more smooth arms meeting in a thickened centre; arms forked at the end. Bacillar spicules are also present in great abundance.

Family IV. Tetracladina.—Desmas quadriradiate, the four arms branched or thickened at the ends, with four axial canals meeting at angles of 120°. Ectosomal spicules generally present in abundance (dichotriænes, phyllotriænes, discotriænes, and "bacillar" spicules).

As a classification of fossil Sponges this has much to recommend it, but the systematist who relies too exclusively on the characters which survive in these mere remnants of organisms cannot hope for more than a very rough approximation to the truth; with all the knowledge which we can obtain from the recent organism we cannot attain to more

[1] Carter, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xii. pp. 349, 437, 1873.

[2] Carter, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xviii. p. 460, 1876.

[3] Zittel, Studien ü. fossile Spongien, II. Lithistidæ, *Abhandl. d. k. baier. Akad. d. Wiss.*, vol. xiii. pp. 65–154; translation, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ii. pp. 113, 235, 324, 385, 467, 1878.

than approximations, and how much less if we found our classification on the fossil rather than on the recent Sponges; in the former the microscleres are inevitably lost in the process of petrefaction, so that not a single fossil Sponge has yet yielded a trace of these important guides, and the characters of the chamber-system, only next important, must necessarily disappear with the soft parts.

The most important observation made by Schmidt bearing on Zittel's classification is the existence of a passage from the Tetracladine type of desma to the Rhizomorine, and this I can fully confirm from my own examination of Schmidt's material; the passage occurs in *Macandrewia clavatella*,[1] and clears up many difficulties as regards the relationships of the Lithistids, a subject that will be discussed directly. O. Schmidt[2] having found that the distinction between the Rhizomorina and the Tetracladina cannot be maintained as absolute, laid great, and as I think undue, stress on another, the presence, namely, of the discotriæne, which he made the character of what he named the "Discodermia" series; the presence of the discotriæne does not correspond either with generic or family distinctions, and can no more be made use of as a classificatory character than say the dichotriæne, as distinguished from the orthotriæne, in the case of the Choristida.

Too little is known of the characters of the soft parts in the Lithistida to enable us to judge how far they may be useful in classification. In the following five species, *Theonella swinhoei*, *Discodermia discifurca*, *Corallistes typus*, *Corallistes masoni*, and *Pleroma turbinatum*, the chamber system is aphodal, and the choanosomal mesoderm sarcenchymatous, in *Azorica pfeifferæ* the chamber system is diplodal and the choanosomal mesoderm of an exceptional character (*vide* p. 321). The difference between an aphodal and diplodal chamber system in the Lithistida is not very marked, and is not of the same importance as that between the aphodal and eurypylous systems. It is of interest, however, to observe that the species enumerated as possessing an aphodal system are more closely related to one another than to *Azorica*, which is widely separated from them on other grounds. The size of the chambers in six species, viz., *Theonella swinhoei*, *Discodermia discifurca*, *Corallistes typus*, *Corallistes masoni*, *Siphonidium capitatum*, and *Azorica pfeifferæ*, is very similar, ranging from 0·015 to 0·024 mm. in length, by 0·018 to 0·031 mm. in breadth; in *Pleroma turbinatum* it is exceptionally great, viz., 0·04 by 0·044 mm.

The characters on which we must depend for the subdivision of the order are those of the skeleton, including of course the microscleres, the presence or absence of which can be definitely ascertained in most of the existing Lithistida, though never in the fossil forms.

[1] O. Schmidt, Spong. Meerb. v. Mexico, p. 24, 1879. [2] *Loc. cit.*

In an article in the Encyclopædia Britannica I proposed the following classification, which is based on differences in the characters of the desmas :—

Order Lithistida, O. Schmidt.

Suborder I. Tetracladina (Zittel). The desma is tetracrepid.

Family I. Tetracladidæ. With the characters of the suborder. Examples—*Theonella*, Gray; *Discodermia*, Bocage; *Siphonia*, Parkinson.

Suborder II. Rhabdocrepida. The desmas are of various forms, founded on a monocrepid basis.

Family I. Megamorinidæ (Zittel, *emend.*). The desmas are of comparatively large size; the ectosomal spicules are triænes and the microscleres are usually spirasters. Examples —*Corallistes*, O. Sch.; *Dorydermia*, Zittel; *Hyalotragos*, Zittel; *Lyidium*, O. Sch.

Family II. Micromorinidæ. The desmas are of comparatively small size, triænes and microscleres are absent. Examples—*Azorica*, Carter; *Verruclina*, Zittel.

Suborder III. Anomocladina. The desmas with a nucleate massive centrum from which a variable number of arms proceed radiately. Examples—*Vetulina*, O. S.; *Astylospongia*, Roemer.

On becoming convinced of the occurrence of the passage from the tetracrepid to the monocrepid desma, discovered by O. Schmidt to occur in the case of *Macandrewia*; and further recognising the closeness of the affinity which exists between the Tetracladidæ, and Megamorinidæ (as defined above), I made a fresh attempt at classification, and this time based it on the presence and absence of triæne spicules; thus making primary use of the same character that is employed for the separation of the Choristida from the Monaxonida.

In this way the order Lithistida would be divided into two suborders, the Triænophora and Rhabdophora. The Triænophora would be distinguished not only by triænes but by the presence of microscleres and by the larger size of the desma.

Further investigation, however, revealed the presence of microscleres in two Rhabdophorous genera (*Scleritoderma* and *Neopelta*); in the latter an amphiaster is present, in the former a sigmaspire, precisely similar to the typical sigmaspire of the Tetillidæ.

These genera thus agree with the Triænophora in possessing microscleres, and with the Rhabdophora in the absence of triænes. They are truly annectant, or passage-forms through which the Triænophora pass into the Rhabdophora. If they are to be classed with either group it should be with the former since they further resemble them in possessing a special ectosomal spicule. Their inclusion however necessitates a change in the proposed classification, and I now offer the following, in which the presence or absence of special ectosomal spicules and of microscleres serves for the definition of two suborders—the Hoplophora and Anoplia; the Hoplophora are subdivided into two demi,

the Triænosa and Rhabdosa; in the former triæne spicules are present, but not in the latter. The following is a table of the proposed groups:—

Order II. LITHISTIDA.

Suborder I. HOPLOPHORA.

Demus I. Triænosa.

Family I. Tetracladidæ (Tetracladina, Zittel).
Family II. Corallistidæ (Rhizomorina, Zittel).
Family III. Pleromidæ (Megamorina, Zittel).

Demus II. Rhabdosa.

Family I. Neopeltidæ. Family II. Scleritodermidæ.
Family III. Cladopeltidæ.

Suborder II. ANOPLIA.

Family I. Azoricidæ (Rhizomorina, Zittel).
Family II. Anomocladidæ (Anomocladina, Zittel).

Relations of the Lithistida to the Choristida.—The presence of the desma throughout the Lithistida suggests a monophyletic origin for the order, for it is extremely improbable that this form of spicule has been separately evolved more than once. The resemblance of the Triænose Lithistids to the Choristid Streptastrosa is so marked that there can be little doubt of the close phylogenetic connection of the two groups, and further, the fact that the desma commences in the Tetracladidæ as a microcalthrops proves that the order of descent has been from the Choristida to the Lithistida, and not in the reverse direction. Again, since the point of connection with the Choristida is furnished by the Triænosa, it is this which must be regarded as the ancestral demus; the Rhabdosa are descended from it, and from the Rhabdosa the Anoplia.

The adherence of the Lithistida to the Choristida being admittedly through the demi Triænosa and Streptastrosa, the next question that arises is as to which of the families of these demi stand in closest connection, and I think it will be found that these are the Pachastrellidæ on the one hand, and the Tetracladidæ on the other, for if we compare such a Pachastrellid as *Pachastrella abyssi* with such a Tetracladid as *Macandrewia* we shall find a closer correspondence between the complements of spicules of the two, than in the case of any other two members of the two demi; thus each possesses as microscleres, microxeas, microstrongyles, and spirasters, of similar, indeed almost identical characters. Both possess oxeas, and the calthrops of *Pachastrella* are represented by the tetracrepid

desmas of *Macandrewia*. In both, further, the chamber-system is aphodal, and the choanosomal mesoderm sarcenchymatous.

No dichotriænes, however, are present in *Pachastrella*, as there are in *Pleroma* among the Pleromidæ, in most of the Corallistidæ, and in some Tetracladidæ; and though these spicules do not occur in *Macandrewia*, they are represented by the closely similar phyllotriænes, which have been evolved from them. This difference however is not of sufficient importance to shift the connection from the Pachastrellidæ to the Theneidæ (a connection however which by another line of reasoning I admit to be possible), it merely suggests that the Pachastrellid ancestor of the Tetracladidæ possessed dichotriænes which the genus *Pachastrella* has lost.

So far as can be judged from resemblances between existing Sponges, the Tetracladidæ have descended from the Pachastrellidæ, and are the oldest family of the demus. In some respects however the Pleromidæ and Corallistidæ are least removed from what we should conclude was the ancestral type, and it is possible that these families should be regarded not as derived from the Tetracladidæ, but from an ancestor common to them both. Thus in *Pachastrella* some of the calthrops are replaced by triods and oxeas; and in *Macandrewia* some of the tetracrepid desmas by triacrepid and rhabdocrepid ones; if now the ancestral Lithistid possessed a similar mixture of forms, the Tetracladidæ might be regarded as having originated by the selection of the tetracrepid desmas exclusively (the selection being incomplete in the case of *Macandrewia*), and the Corallistidæ and Pleromidæ by a selection of the rhabdocrepid forms. This view is in accordance with the fact that the flagellated chambers in *Pleroma* are larger, and one would therefore presume more primitive, than in any other Lithistid, and indeed than in *Pachastrella* itself. It would also accord with the fact that dichotriænes are more common in the Corallistidæ and Pleromidæ, and phyllotriænes and discotriænes in the Tetracladidæ. The modification thus introduced into our earlier results will be carried still further when we reflect that a Lithistid ancestor with dichotriænes and large flagellated chambers, involves a Pachastrellid ancestor with dichotriænes and large flagellated chambers, and such a Pachastrellid would approach more nearly the Theneidæ than any existing Pachastrellid of which the soft parts have been examined. This is a further indication of the probability that the Pachastrellidæ have been derived from the Theneidæ. On the whole then it would appear that the Lithistida have descended from an extinct pro-Lithistid ancestor, which in turn had descended from an extinct pro-Pachastrellid ancestor, possessing closer affinities with the Theneidæ than do any of the existing forms of the Pachastrellidæ.

From the Triænosa to the Anomocladidæ we are presented with an almost continuous series of gradually simpler forms, simpler, that is, as regards the characters of the skeleton. Thus in the Rhabdosa triænes have disappeared, and while in one family (Cladopeltida) microscleres are absent, in another they are sigmaspires (*Scleritoderma*).[1]

[1] In this case at all events the sigmaspire is to be regarded as a degenerate and not as a primitive spicule; of course, one is left with a last appeal to "reversion."

With this simplification proceeds a diminution in the size of the desma, so that in the *Rhabdosa* and in the *Anoplia* it is much smaller than in most of the Triænosa. In the *Anoplia* ectosomal spicules have disappeared, but the desma is still rhabdocrepid in the Azoricidæ; in the Anomocladidæ, however, even the crepis disappears, and we are left with a skeleton of acrepid desmas and rhabdi. It is worthy of note that, notwithstanding the simplification attained by *Vetulina*, the only existing Anomocladid, the mass of its skeleton as compared to that of the sponge is larger than in any other Lithistid, probably larger than in any other known sponge.

A summary of the foregoing classification and an account of families and genera will now be given :—

Tribe TETRACTINELLIDA, Marshall.

Tetractinellida, Marshall, Zeitschr. f. wiss. Zool., Bd. xxvii. p. 134, 1876.

Demospongiæ in which triæne or tetraxon megascleres, or Lithistid desmas, are present.

These characters fail in a single family, the Placospongidæ, with a single genus, *Placospongia*; this is included in the Tetractinellida on account of the presence of sterrasters, which are not known in any other Sponge outside the Tetractinellida.

Order I. CHORISTIDA, Sollas.

Choristida, Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 386, 1880.

Tetractinellida in which Lithistid desmas are absent, and the megascleres are never articulated to form a coherent skeleton.

Suborder I. SIGMATOPHORA, Sollas.

Sigmatophora, Sollas, Article "Sponges," Encyclopædia Britannica, vol. xxii. p. 423, 1887.

Choristida in which the microsclere, when present, is a sigmaspire.

Family I. TETILLIDÆ, Sollas.

Group *Tethyina*, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xvi. p. 67, 1875.
Tetillidæ, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 178, 1886.

Historical.—The earliest described species of Tetillid Sponge is *Craniella* (*Alcyonium*) *cranium*, Müller.[1] This was subsequently associated by Lamarck with a Monaxonid Sponge, *Tethya lyncurium*, in the same genus *Tethya*, Lamarck.[2] That *Tethya cranium* and *Tethya lyncurium* are generically different was first recognised by Gray,[3] on whom devolved the responsibility of finding a new name for one of them. *Tethya lyncurium*

[1] Müller, Zool. Dan., pl. lxxxv. fig. 1, 1789.
[2] Lamarck, *Mém. d. Mus.*, t. i. p. 71, 1815.
[3] Gray, *Proc. Zool. Soc. Lond.*, p. 543, 1867.

is a combination that by the accepted laws of nomenclature cannot possibly be disturbed, since the species is the type of the genus so named by Lamarck, and accepted and redefined by O. Schmidt in 1862. A new name should therefore have been found for *Tethya cranium*. Gray, however, unfortunately substituted Nardo's name, *Donatia aurantiaca*, for *Tethya lyncurium*, of which it is a mere synonym, and left *Tethya cranium* to stand. This proceeding has naturally led to some confusion, but the error was not long left uncorrected. O. Schmidt,[1] some three years later, proposing a new genus, *Craniella*, to receive *Tethya cranium*, and leaving *Tethya lyncurium* in enjoyment of its established rights. O. Schmidt, however, included *Craniella* and its near allies, together with less closely connected Sponges, such as *Stelletta*, in his family Ancorinidæ; and we owe to Carter[2] their separation as a distinct subfamily group. Carter, adopting Gray's nomenclature for *Craniella cranium*, named this group Tethyina, a term which it is impossible to retain. The Challenger material has added two new genera to the group, and it has become important enough to be raised to distinct family rank; indeed, independently of these fresh accessions, its claim to be regarded as a distinct family would naturally be admitted on account of the sharp line of demarcation which exists between it and the other members of Schmidt's Ancorinidæ. Selecting *Tetilla*, the most primitive genus of the family, as the type, I propose for it the name Tetillidæ.

Definition.—The Tetillidæ are Sigmatophora distinguished by characteristic protriænes, which never fail, and by sigmaspires, which not unfrequently are absent.

No other Sponge can well be mistaken for a Tetillid; wide and numerous as are the variations which occur within the limits of the family, the facies remains the same; it is not always easy to say on what particulars a facies depends; in this case I think these will be found first in the form of the protriæne, which is not exactly repeated in any other group of Sponges; next the anisoactinate character of the oxeas may have something to do with it, for though such spicules occur in other Tetractinellids, I do not know of any in which they are present to the same extent; finally the sigmaspires when present are highly characteristic.

The Skeleton.—The different forms of megascleres met with in the family are—

1. A somal oxea, which varies from 1·27 to 8 mm. in length according to the species; it is usually anisoactinate but sometimes isoactinate, the ecactine being shorter and more bluntly pointed than the esactine.

2. A cortical oxea, which differs from the somal chiefly in being much smaller and usually isoactinate.

3. Protriænes, which may be isocladose, or anisocladose in the latter case two; of the cladi are usually of equal size, and smaller than the third. These spicules, as also the oxeas, are frequently trichodal.

[1] O. Schmidt., Spong. Atlant. Gebiet., p. 66, 1870.
[2] Carter, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xvi. p. 67, 1875.

4. A plagiotriæne, with a very much reduced rhabdome; this spicule, which has been met with in one species only, is very similar to a calthrops (*Tetilla merguiensis*, Carter).

5. Anatriænes; a somal form of this spicule can sometimes be distinguished from a radical form,—in the latter the cladome is usually grapnel-like, in the former hastate.

6. Reductions of both the protriænes and the anatriænes are far from infrequent, one or two of the cladi being suppressed, thus anadiænes, prodiænes, and monænes result.

Microscleres are usually present, though not always, and sometimes they are of more than one form; if there is but a single form it is invariably a sigmaspire, if more than one, one of them is a sigmaspire. In two species the sigmaspire is spined (*Tetilla japonica*, Lampe, and *Craniella atropurpurea*, Carter); in one it is centrotylote (*Tetilla geniculata*, Marenzeller). The additional forms of microscleres are toxaspires, which occur in *Chrotella macellata* as the special microscleres of the cortex, those of the choanosome remaining as unmodified sigmaspires; microstrongyles of variously curved forms, which occur in *Tetilla stipitata*, Carter, and microxeas, *Tetilla australiensis*, Carter. Minute globules are associated with the sigmaspires in several species both of *Tetilla* and *Craniella*.

The number of different forms of megascleres present in the same species differs greatly; in some, *e.g.*, *Tetilla sandalina*, only oxeas and protriænes may occur, in others nearly all the forms which have been enumerated as occurring within the group. The somal megascleres are more or less closely associated together in bundles or fibres, which generally, if not always, radiate from a spicular centre or so-called nucleus, which is excentrically situated within the Sponge, from this they diverge in a more or less spiral course to the exterior. The cladomes of the triænes do not attain their full growth till they reach or enter the ectosome. In some species of *Tetilla* the interspaces between the radial fibres are crossed by loosely scattered oxeas, not aggregated into fibres.

The cortical megascleres, which are always oxeas, may be loosely and irregularly scattered through the cortex or more or less radially arranged (*Craniella*).

The Ectosome.—In the simplest forms, such as *Tetilla sandalina*, there is a total absence of cortex, and the ectosome is a mere investing membrane, the choanosome with its flagellated chambers sometimes extending close up to the outer epithelium. From this stage the gradual evolution of the cortex is traceable in different directions, in *Tetilla leptoderma* and *Tetilla grandis* the ectosome is developed as a thin layer of fibro-vesicular collenchyma; in *Chrotella simplex* this increases in thickness and becomes extensively excavated by intercortical cavities; corresponding with this advance we find a slightly greater development of fusiform cells in the inner layer of what may now be termed the cortex; in *Craniella*, which completes the series in this direction, the inner layer of the cortex is clearly differentiated from the outer, the latter persisting as a collenchymatous tissue excavated by intercortical cavities, the former—converted into a fibrous tissue by the rich development within it of fusiform cells—

constituting one-half the thickness of the whole cortex. These two layers may be distinguished as the inner and outer layers of the cortex. In the Sponges with a cortex excavated by intercortical cavities, the pores are distributed generally in sieve-like groups over the whole external surface; in *Cinachyra* they are restricted to special poriferous recesses, invaginated into the choanosome, hence in this sponge there is no longer any need for intercortical cavities, and accordingly the cortex is solid throughout, consisting mainly of a densely fibrous layer of fusiform cells, with a minimum of associated gelatinous matrix.

The Oscules may be the simple openings of single excurrent canals (*Tetilla*), or the mouths of special cloacal recesses (*Chrotella macellata*, *Cinachyra barbata*), or each may be the mouth of a system of intercortical cavities, which receive several excurrent canals. These canals pass through the inner layer of the cortex and open into the intercortical cavities by sphinctrate apertures (*Craniella*).

Associated with the progressive modification of the ectosome are certain changes in the character of the mesoderm and the chamber-system; the collenchymatous mesoderm of the non-corticate species (*Tetilla*) becomes a granular collenchyma in the simpler corticate species (*Chrotella*), and a true sarcenchyme in the higher (*Craniella*); correspondingly the flagellated chambers pass from a eurypylous to an aphodal stage, at the same time becoming reduced in size (from about 0·071 by 0·044 mm. in *Tetilla*, to 0·025 by 0·035 mm. in *Craniella*).

Genital Products.—Ova have been met with in *Chrotella macellata*, and spermatozoa in sperm-clusters in several species, in *Tetilla pedifera*, *Tetilla grandis*, *Chrotella macellata* (in which they occur in vast numbers in the vicinity of the cloacas), and in *Craniella schmidtii*; they have also been observed in *Craniella cranium*.

Development.—The embryos and young Sponges observed in *Craniella simillima* and *Craniella schmidtii* are described on pp. 33, 40.

Genus 1. *Tetilla*, O. Schmidt.

Tetilla, O. Schmidt, Spong. Küste v. Algier., p. 40, 1868.
„ O. Schmidt, Spong. Atlant. Gebiet., p. 66, 1870.
„ Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 179, 1886.

The ectosome is never differentiated to form a cortex, and never provided with special spicules. It may be absent altogether, *i.e.*, represented only by the layer of investing epithelium, or it may exist as a layer of soft fibro-vesicular collenchyma, as much as 0·5 mm. thick. The mesoderm is a collenchyma; and the canal-system eurypylous. The megascleres are arranged in radiating fibres, but separate oxeas are also present, crossing those of the fibres transversely.

Type—*Tetilla euplocamus*, O. Schmidt.

Genus 2. *Chrotella*, Sollas.

Chrotella, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 180, 1886.

The ectosome is a soft cortex, consisting of fibro-vesicular collenchyma, excavated by extensive intercortical cavities or sinuous canals; the inner layer is not differentiated from the outer, but contains a large number of fusiform cells arranged tangentially.

The spicules of the cortex are scattered through it in various directions, but rarely radiately.

The choanosome consists of granular collenchyma or sarcenchyme, the chamber-system is eurypylous or aphodal.

The excurrent canals may open to the exterior in simple oscules or by a common cloaca.

The somal megascleres are arranged in radiating fibres, which are crossed by loosely scattered oxeas lying more or less transversely.

Type—*Chrotella simplex*, Sollas.

There is a second species, *Chrotella macellata*, which differs from the type in possessing large excurrent cloacas, this may be regarded as a character of generic importance, but I am unwilling to establish more genera with single species than are absolutely necessary.

Genus 3. *Cinachyra*, Sollas.

Cinachyra, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 182, 1886.

The ectosome is a thick cortex, which consists chiefly of a dense fibrous felt of fusiform cells, only passing into a thin layer of collenchyma close to the outer surface. Cortical oxeas, chiefly confined to the outer three-quarters of the cortex, traverse it radially at right angles to the surface.

The cortex is solid throughout, without intercortical cavities.

The excurrent and incurrent apertures are confined to special flask-shaped recesses, formed by an inflection inwards of the cortex; the mouth of each recess is sphinctrate, and the walls are perforated by pores, which communicate with the excurrent or incurrent canals as the case may be.

The somal megascleres are collected into fibres which take a spiral course within the Sponge; no separate megascleres are strewn through the choanosome transversely to these fibres.

The mesoderm of the choanosome consists of a granular collenchyma. The chamber-system is eurypylous.

Type—*Cinachrya barbata*, Sollas.

Genus 4. *Craniella*, O. Schmidt.

Craniella, O. Schmidt, Spong. Atlant. Gebiet., p. 66, 1876.
„ Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. ix. p. 149, 1882; Sci. Proc. Roy. Dubl. Soc., p. 181, 1886.

The cortex is differentiated into an inner fibrous layer, traversed radially by cortical oxeas; and an outer collenchymatous layer, excavated by intercortical cavities.

The pores lie in groups, perforating the roofs of the intercortical cavities; the oscules are distinguishable from the pores, and are usually few in number.

The mesoderm of the choanosome consists of sarcenchyme. The chamber-system is aphodal.

Type—*Craniella cranium*, Lamarck.

Family II. Samidæ, Sollas.

Samidæ, Sollas, Encyclopædia Britannica, vol. xxii. p. 423.

History.—The genus *Samus*, on which this family is founded, was included by Gray in the family Clioniadæ, Gray.[1] With *Cliona*, the type of this family, it has evidently no near relation. Carter having founded a family very similar to the Clioniadæ, viz., the Ececœlonidæ,[2] to contain the three genera, *Cliona*, *Thoosa*, and *Alectona*, subsequently added *Samus* to it and another new genus *Dotona*.[3] The family Ececœlonida not being established on morphological characters, but on a peculiarity of habit only, could scarcely be expected to stand, and a very slight examination is sufficient to convince us of the want of morphological affinity between its components. The family evidently cannot be defended, but even were this not the case, the genus *Samus* would have to be removed from it, since it possesses no essential character in common with its associates. The presence of the amphitriæne, the only megasclere it possesses, indicates its place with the Tetractinellida; the sigmaspire similarly with the Sigmatophora; within this demus it must be included as the representative of a distinct family.

Definition.—Sigmatophora in which the characteristic megasclere is an amphitriæne.

Genus *Samus*, Gray.

Samus, Gray, Proc. Zool. Soc. Lond., p. 526, 1867.
„ Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 59, 1880.

With the definition of the family.

Type—*Samus anonymus*, Gray.

[1] Gray, *Proc. Zool. Soc. Lond.*, p. 526, 1867.
[2] Carter, *Journ. Roy. Micr. Soc.*, vol. ii. p. 496, 1879.
[3] Carter, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vi. p. 56, 1880.

PHYLOGENY OF THE SIGMATOPHORA.

Suborder II. ASTROPHORA, Sollas.

Asterophora, Sollas, Encyclopædia Britannica, vol. xxii. p. 423, 1887.

Choristida in which one or more of the microscleres is an aster.

Demus I. STREPTASTROSA, n. n.

Spirastrosa, Sollas, Encyclopædia Britannica, vol. xxii. p. 423, 1887.

Astrophora in which one of the microscleres is a spiraster, or when this is not the case one of the megascleres is a calthrops.

The name originally given to this group, Spirastrosa, is too similar to that adopted by Ridley and Dendy for a Monaxon family, Spirastrellidæ, and for the sake of distinction Streptastrosa is now substituted.

Family I. THENEIDÆ, Sollas.

Group *Theneanina*, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xi. p. 354, 1883.
Theneidæ, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 178, 1886.

History.—This family is founded on the genus *Thenea*, Gray, who evidently had some notion of the value of the spiraster in classification; a point that was subsequently insisted on by myself both as distinguishing *Thenea* from *Stelletta* and as allying it with *Pœcillastra*.[1] It was next made use of by Carter, who chose it as the distinctive character of a subfamily, which he named Theneanina, including in it the genera *Thenea* and *Pœcillastra*. The group is here regarded as of family rank.

Definition.—Streptastrosa in which the microscleres are spirasters or amphiasters, and oxyasters or microxeas.

The ectosome never forms a cortex. The mesoderm is a collenchyma. The chamber-system is eurypylous.

The family cannot be defined by the spiraster alone, as this is also present in the Pachastrellidæ, which no doubt are very closely allied to the Theneidæ, bearing somewhat the same relation to them that the simpler genera of Tetillidæ do to the more complex.

[1] Sollas, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ix. pp. 434, 443.

The Pachastrellidæ cannot, however, be included in the same family (as the higher Tetillidæ are with the lower), because they afford a new point of departure for fresh modifications of the microscleres, as is illustrated in the difference between these spicules in *Dercitus* and *Pachastrella*.

The Theneidæ are evidently an annectant group, uniting the Pachastrellidæ and the Stellettidæ with the Tetillidæ.

Genus 1. *Thenea*, Gray.

Thenea, Gray, Proc. Zool. Soc. Lond., p. 541, 1867.
„ Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. ix. p. 429, 1882.
„ Vosmaer, Niederl. Archiv f. Zool., Suppl.-Bd. p. 5, 1882.

History.—A full account of the history of this genus appears in my Report of the Sponges collected by the Rev. Dr. Norman from Kors Fjord, Norway (*loc. cit. supra*). It will therefore not be necessary to give more than a short summary here. The name *Thenea* was first proposed by Gray (*loc. cit.*) to include *Tethya muricata*, Bowerbank.[1] Subsequently various authors described other specimens of this Sponge without recognising their identity with it or with each other, and so bestowed new names upon them; thus we have *Tisiphonia*, proposed by Wyville Thomson,[2] *Wyville-thomsonia*, by Perceval Wright,[3] and *Dorvillia*, by Saville Kent.[4] After the resuscitation of the name *Thenea*, which it should be mentioned had been already recommended by Perceval Wright, a paper appeared by Vosmaer in which its adoption was also advocated (*loc. cit. supra*), and it may now be taken as definitely established; Carter,[5] who was inclined to another view, at length giving in his adherence.

Definition.—Theneidæ of symmetrical form, with one or more well-defined oscules, and specialised poriferous areas, in addition to pores generally distributed. The distinctive spicules are dichotriænes, which together with the other megascleres are radially arranged.

The species of *Thenea* are usually agariciform, and either radiately or bilaterally symmetrical, in the radiate forms an upper moiety is usually separated from a lower by a special poriferous recess, which is equatorial in position and either continuous or broken up into a series of more or less oval areas; the upper moiety or "pileus" bears the oscule, or oscules, and ends in a sharp "tegminal" edge, often continued into a fringe of spicules, overhanging the poriferous recess; in bilaterally symmetrical forms, from which all trace of radiate symmetry has disappeared, the distinction into a pileus and basal portion fails

[1] Bowerbank, *Proc. Zool. Soc. Lond.*, p. 115, 1872; Mon. Brit. Spong., vol. i. pp. 25, 108, 1864; see also p. 95 of descriptive part of this Report.
[2] Wyville Thomson, *Phil. Trans.*, p. 712, 1869.
[3] E. P. Wright, *Quart. Journ. Micr. Sci.*, vol. x. p. 7, pl. ii., 1870.
[4] Saville Kent, *Monthly Micr. Journ.*, p. 293, pl. lxvi., 1870.
[5] Carter, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xi. pp. 354, 362, 1883.

owing to the lateral position of both oscule and poriferous recess, which are of nearly equal size and situated on opposite sides of the Sponge.

As a rule radical fibres descend from the base of the Sponge and either end separately in splayed out leashes, or become matted together into a basal mass.

The spicules usually include the following :—

I. Megascleres—(1) oxea ; (2) protriæne or plagiotriæne ; (3) dichotriæne with very long deuterocladi ; (4) anatriæne, which may be differentiated into a somal and radical form.

II. Microscleres—(1) spiraster, or amphiaster ; (2) metaster, and (3) plesiaster or oxyaster.

Although the mesoderm is always collenchymatous, it is very variable in quantity, sometimes being reduced to a minimum, so that the folding of the choanosomal plate is obvious, sometimes on the other hand increasing to so great an extent that no suggestion of the origin of the canal-system by folding is discernible, the canals being provided with thick collenchymatous walls, and vela occurring at intervals no further apart than the diameter of the canal, which is thus converted into a succession of vesicles. Reproduction is both sexual and asexual (by external gemmation).

Genus 2. *Characella*, Sollas.

Characella, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 187, 1886.

Thenеidæ of irregular form ; oscules and pores not regularly distributed ; megascleres not radially arranged, consisting of oxeas and orthotriænes and dichotriænes ; the triænes are confined to the ectosome. The microscleres are microxeas and amphiasters. The mesoderm is a collenchyma, containing numerous granules.

Type—*Characella aspera*, n. sp.

This genus is closely allied to *Pœcillastra*, from which it differs by the absence of triænes from the choanosome. The character of the mesoderm may furnish another point of distinction.

Genus 3. *Pœcillastra*, n. n.

Normania, Bwk., Norman, Brit. Assoc. Report, p. 328, 1868.
„ Bowerbank, Mon. Brit. Spong., vol. iii. p. 258, 1874.
„ Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 185, 1886.

Thenеidæ without special symmetry, but usually of plate-like form, bearing on one surface the oscules and on the opposite the pores, which are never collected into special recesses. The skeleton consists of oxeas, triænes, and calthrops, which are aggregated into more or less longitudinal and transverse bundles or indistinct fibres, the triænes

occupying the usual position in the ectosome and the calthrops occurring in the choanosome. Anatriænes are absent. The microscleres are spirasters, plesiasters or oxyasters, and microxeas.

History.—The Sponge on which Bowerbank founded this genus was named by him *Normania crassa*, it was dredged off Shetland by the Rev. A. M. Norman (*vide* p. 98). First mentioned in the British Association Report (*loc. cit.*), it was afterwards fully described in the Monograph of the British Sponges (*loc. cit.*). In 1878 Carter[1] stated that *Ecionema compressa*, Bowerbank, 1866, *Hymeniacidon placentula*, Bwk., 1874, and *Normania crassa*, Bwk., 1868, are identical species, and only varietally different from *Thenea muricata*. Specimens placed in my hands by the Rev. Dr. Norman for the purpose, enabled me to confirm this statement as regards the identification of the first three species, but not as regards the closeness of their association with *Thenea muricata*.[2]

This was clearly an error, as Norman[3] has also pointed out, and as Carter[4] has since admitted.

Since the first three species are identical it becomes necessary to make a choice of generic and specific names. And first as to the genus. *Hymeniacidon* can at once be put out of court; whatever else that genus may be it does not belong to the Tetractinellida. There remain *Ecionema* and *Normania*; Carter, on the ground that *Ecionema* has precedence, declares for it, I think, somewhat hastily; the genus *Ecionema* was defined by Bowerbank[5] in 1864, and the species *Ecionema acervus*, Bwk., specially assigned to it as the type. The genus cannot therefore be used to include species generically different from *Ecionema acervus*. Now this species, as we know from Bowerbank's[6] descriptions with full illustrations given later, does not even belong to the family Theneidæ; it is plainly a member of the Stellettidæ, and stands there as the type of the genus *Ecionema*.

Ecionema therefore is not available as a generic name for *Normania crassa*, *Hymeniacidon placentula*, and *Ecionema compressa*; and *Normania* alone remains with a claim; I should have much preferred to retain this as connecting Norman's name with the Sponges, in the investigation of which he has rendered such invaluable assistance; but it appears to have been preoccupied; true, Bowerbank remarks that Brady's genus *Normania*, which has precedence, cannot stand, but this makes no difference, since according to convention, a discarded name which has ceased to be used for one species, or genus, cannot be applied to another, otherwise the door would be opened to confusion. I therefore propose to rename the genus *Pœcillastra*.

[1] Carter, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ii. p. 174.
[2] Sollas, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ix. p. 433, 1882.
[3] Bowerbank, Mon. Brit. Spong., vol. iv. p. 29, 1882.
[4] Carter, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xi. p. 359, 1883.
[5] Bowerbank, Mon. Brit. Spong., vol. i. p. 173, 1864.
[6] Bowerbank, *Proc. Zool. Soc. Lond.*, p. 322, pl. xxx. figs. 1–6, 1873.

Genus 4. *Sphinctrella*, O. Schmidt.

Sphinctrella, O. Schmidt, Spong. Atlant. Gebiet., p. 65, 1870.
Vulcanella, Sollas, Sci. Proc. Roy. Dubl. Soc., N.S., vol. v. p. 186, 1886.

Thenoidæ of no regular form, distinguished by one or more large oscules, which are fringed at the margin by long oxeas, and lead into cloacas with fenestrated walls. Special poriferous recesses are absent. The spicules and skeleton are similar to those of *Pœcillastra*.

Type—*Sphinctrella horrida*, O. Schmidt.

The Sponge on which I founded the genus *Vulcanella* is so different in general form and outward appearance from *Sphinctrella horrida*, and Schmidt's descriptions are so incomplete, that it was not till I had an opportunity of examining a fragment of Schmidt's species that I noticed the resemblance; since then I have found in the Challenger collection two other species, which are more like *Sphinctrella horrida* in general character, and there can be little doubt as to the identity of *Vulcanella* with *Sphinctrella*.

Genus 5. *Triptolemus*, n. gen.

Thenoidæ of no regular form, usually incrusting. Oscules and pores not known. The megascleres include an oxea and centrotriæne, the microscleres a spiraster and spinose microxea.

Type—*Triptolemus cladosus*, n. sp. (p. 93).

The first discovered species of this genus were assigned by Carter,[1] who described them, first to *Pachastrella*, and subsequently to *Samus*; beyond the characters and arrangement of the spicules, but little is known about them, and so long as the characters of the chamber-system are uncertain, the position of the genus is more or less open to question.

Genus 6. *Stœba*, n. gen. (provisional).

Thenoidæ of no regular form; in the only species known burrowing. The megascleres are dichotriænes, the microscleres spinose microxeas.

Type—*Stœba simplex* (Carter) (p. 102).

This is another of the Sponges assigned by Carter to the genus *Samus*; in that genus as redefined by us it cannot be included, and since there is no other existing genus to which it can be referred, it becomes necessary to institute a new one to receive it.

[1] Carter, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xviii. p. 410, 1876; Carter, *op. cit.*, ser. 5, vol. vi. p. 60, 1880.

Genus 7. *Nethea*, n. gen. (provisional).

Theneidæ of no regular form; in the only species known, incrusting or burrowing. The megascleres are an oxea and a dichotriæne, with the rhabdome reduced to a tubercle.

Type—*Nethea nana* (Carter) (p. 103).

This species is regarded by Carter as a *Thenea*; as this is a view which cannot be maintained, we are led as in the case of the preceding species to institute a new genus for its reception.

Genus 8. *Placinastrella*, F. E. Schulze.

Placinastrella, Schulze, Zeitschr. f. wiss. Zool., Bd. xxxv. p. 449, 1880.

Theneidæ in which the megascleres are calthrops, triods, and oxeas; the calthrops when situated near the surface is orientated like a triæne which it then much resembles. The microscleres are of two orders of size, a larger consisting of tri- and di-actinose oxyasters, and a smaller, chiefly confined to the ectosome, and consisting of tetra-, tri-, and di-actinose oxyasters.

Type—*Placinastrella copiosa*, F. E. Schulze (p. 103).

This genus is referred to the Theneidæ with many misgivings. It reminds one very much of *Pacillastra* in the arrangement of the microxeas (diactinose oxyasters), but differs from it and from other genera of the Theneid family in the absence of spirasters; indeed, by this deficiency it should, according to definition, be excluded from the family, and it may be necessary to restore it to the Placinidæ, in which family Schulze originally placed it. The mode of arrangement of the microxeas in the ectosome, which they traverse at right angles to the surface, is very characteristic, and reminds one of a similar arrangement in the *Suberites*.

Family II. Pachastrellidæ (Carter).

Pachastrellina, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xvi. pp. 48, 68, 82, 1875.
Pachastrellidæ, Sollas, *emend.*, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 177, 1886.

Definition.—Streptastrosa in which the chief megascleres are calthrops, triænes being absent. The microscleres may be spirasters, spherasters, or microrabds.

The choanosomal mesoderm is sarcenchymatous, and the chamber-system aphodal.

History.—The family "Pachastrellida," as founded by Carter, is the fourth of the order "Holoraphidota," Carter, and includes the two subfamilies—"groups" Carter—Pachastrellina and Lithistina (the latter equivalent to our order Lithistida); it is perhaps

owing to its being thus too inclusive that it has not met with general adoption; as used in our scheme of classification the family Pachastrellidæ is nearly equivalent to the group or subfamily Pachastrellina, Carter.

The family is closely allied through *Pachastrella abyssi*, O. Schmidt, with the Theneidæ, its nearest relation in this family being the genus *Pœcillastra;* by the possession of an aphodal chamber-system and sarcenchymatous mesoderm the Pachastrellidæ are, however, raised to a higher grade than the Theneidæ, and thus in framing our phylogeny of the Streptastrosa we have regarded the Theneidæ as the ancestral group.

It is only as a matter of convenience, however, that the Pachastrellidæ are included in the Streptastrosa, since the only genus which possesses the characteristic spiraster is *Pachastrella* itself; the other two genera of the family differ widely from this, first in the absence of rhabdal megascleres, and next in the characters of the microscleres, which in *Dercitus* are a toxa and microrabd, and in *Calthropella* a spheraster; the sole character by which these genera are united with *Pachastrella* lies therefore, so far as the spicules are concerned, in the calthrops, which is common to all. In *Dercitus* the characters of the chamber-system and mesoderm are not known.

Genus 1. *Pachastrella*, O. Schmidt.

Pachastrella, O. Schmidt, Spong. Küste v. Algier., p. 15, 1868.

Pachastrellidæ in which the megascleres are calthrops and oxeas, the microscleres spirasters, microstrongyles, and (?) microxeas.

Type—*Pachastrella monilifer*, O. Schmidt (p. 110).

Genus 2. *Dercitus*, Gray.

Dercitus, Gray, Proc. Zool. Soc. Lond., p. 542, 1867.
Pachastrella, O. Schmidt, Spong. Atlant. Gebiet., p. 76, 1870.
Battersbya, Bowerbank, Mon. Brit. Spong., vol. iii. p. 347.

Pachastrellidæ in which the microscleres are spined microrabds and toxas.

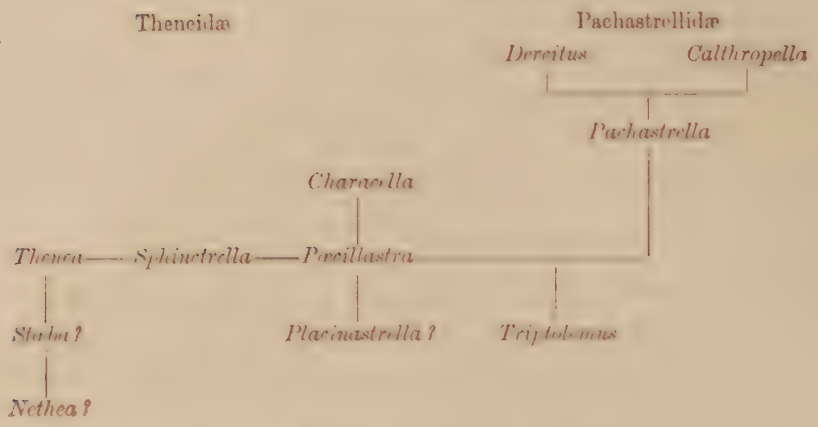
Type—*Dercitus bucklandi*, Bowerbank (p. 108).

Genus 3. *Calthropella*, n. gen.

Pachastrellidæ with only one form of microsclere, which is a euaster. The only megascleres are calthrops, oxeas being absent.

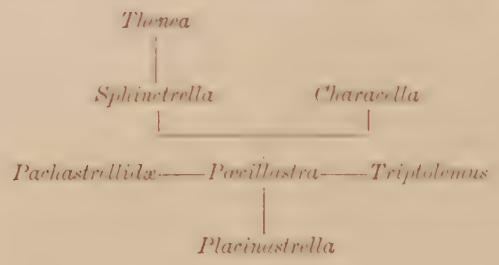
Type—*Calthropella simplex*, n. sp. (p. 107).

PHYLOGENY OF THE STREPTASTROSA.



In this scheme *Pavillastra* is doubtfully supposed to have originated from *Thenea*-like Sponges, which may have been nearly allied to *Sphinctrella*, some of the species of which are incrusting and others not, but none possess dichotriænes like those of *Thenea*. *Nethea* and *Staba* are supposed on account of their burrowing habits to be degenerate forms.

As an alternative scheme for the Thenciдæ the following may be suggested :—



Demus II. EUASTROSA, Sollas.

Euastrosa, Sollas, Encyclopædia Britannica, vol. xxii. p. 423, 1887.

Astrophora in which euasters are always present, but never spirasters nor sterrasters. Triænes are present but not calthrops.

Family I. STELLETTIDÆ.

Group *Stellettina*, Carter, Ann. and Mag. Nat. Hist., ser, 4, vol. xvi. pp. 48, 67, 81, 1875.

History.—The central type of this family is the genus *Stelletta*, which was originally defined by O. Schmidt in 1862[1] and at that time placed by him amongst the so-called

[1] O. Schmidt, Spong. Adriat. Meeres, p. 46, 1862.

Corticata. In 1870 Schmidt[1] proposed the family Ancorinidæ to include Sponges with "anchor"-shaped spicules, but without sterrasters. The genera enumerated as belonging to the family are:—*Pachastrella*, *Sphinctrella*, *Tetilla*, *Craniella*, *Ancorina*, and *Stelletta*; all then defined by Schmidt for the first time.

In 1875, Carter proposed the group Stellettina as one of the subdivisions of his family Pachytragida, which was defined as including "Sponges more or less corticate, with a cancellous, more or less radiated structure, internally well differentiated." This family can no longer be maintained, at least not without a revision of the definition and a change in the name, as neither are any longer indicative of the Sponges it includes. At the same time in its essential features the family is a very natural one; much more so than O. Schmidt's. It was subdivided into three groups of subfamily value:—the Geodina, Stellettina, and Tethyina (Tetillidæ). The Stellettina were rightly distinguished from the Geodina by the absence of sterrasters, a distinction already made by Schmidt between his Ancorinidæ and Geodiadæ. In 1880 Carter,[2] recognising the essential similarity between *Camicus*, *Pachymatisma*, and *Erylus*, suggested that these genera, "although belonging to the Geodina, should constitute a different group from the *Geodia* proper." Subsequently, however, in 1883, Carter[3] enlarged the contents of the group Stellettina by referring to it the genus *Erylus*, Gray (*Stelletta mamillaris* and *Stelletta discophora*, O. Schmidt), although he had previously rightly regarded *Erylus* as a Geodiid genus, and I fail to perceive the reasons for his change of view. The essential features of the sterraster are not affected by its form, and are as obviously present in the *Erylus* "disc" as in the Geodine "globate"; it is true, however, that the recurved spines which usually terminate the actines of the Geodine sterraster are not present in the Eryline, and this difference is connected with a difference in the mode of union of these spicules to form the sterrastral layer of the cortex; but these differences are less considerable than those which distinguish the sterraster, whether Eryline or Geodine, from all astral spicules of the Stellettidæ.

In 1880 O. Schmidt,[4] in adopting the division Tetractinellida, abandons the distinction between the families Ancorinidæ and Geodinidæ as these were defined by him; and quite rightly so, since the contents of the Ancorinidæ differ far more from one another than from the Geodiidæ. The distinction has, however, been quite recently revived by Vosmaer;[5] no reasons are assigned for this step, and the Ancorinidæ of Vosmaer are, if possible, a more disorderly assemblage of diverse forms than that of Schmidt. Including too much and excluding too much, I see no way to accepting it, and prefer to adopt Carter's group Stellettina, at the same time raising it to the value of a distinct family.

[1] O. Schmidt, Spong. Atlant. Gebiet., p. 64, 1870.
[2] Carter, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vi. p. 137, 1880.
[3] Carter, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xi. p. 347, 1883.
[4] O. Schmidt, Spong. Meerb. Mexico, p. 60, 1880.
[5] Vosmaer, Bronn's Klass. u. Ord. d. Thierreichs, Porifera, p. 318, 1885.

Definition.—Euastrosa in which the megascleres are oxeas and triænes. The chamber-system is aphodal and the mesoderm of the choanosome sarcenchymatous. The ectosome may or may not form a cortex.

There may be but one form of aster or there may be two or more forms present; in the former case the additional aster is usually a euaster or a euaster reduced to a microrabd, but there are some few cases (*Tribrachium*, *Tethyopsis*, *Disyringa*) in which it is a sanidaster, and one in which it is an irregular form of amphiaster (*Stryphnus*).

The arrangement of the megascleres is as a rule on the "radiate type," even when absent in large fully grown Sponges this arrangement usually occurs in the young Sponge; but there are one or two cases in which there is an almost total absence of arrangement in all known stages, *e.g.*, in *Stryphnus*, and the species *Stelletta pathologica*, O. Schmidt, of which the generic relations are obscure.

The triænes invariably present are usually ortho- or dicho-triænes, the former, however, sometimes replaced by plagiotriænes; anatriænes may or may not be present in addition. In *Stelletta pathologica* remarkable centrotriæne forms are met with, and these attain their full development in the choanosome as well as in the ectosome, while in the rest of the family the triænes are never fully grown till they reach the ectosome or its vicinity.

In the following genera the ectosome does not form a cortex:—*Myriastra*, *Anthastra*, *Ecionema*; in the following the cortex is chiefly spicular:—*Aurora*, *Papyrula*, *Stryphnus*, *Algol*; in the remainder chiefly fibrous or fibro-spicular:—*Pilochrota*, *Astrella*, *Psammastra*, *Tribrachium*, *Ancorina*, *Disyringa*, *Tethyopsis*.

Classification of the Stellettidæ.—The only attempt yet made to reduce the species of the overgrown genus *Stelletta* (for our Stellettidæ is almost equivalent to Schmidt's genus) to order is that of Carter, whose classification is as follows:—

"Group Stellettina.

"Subsection I. Psilodermata:—'Thin-skinned Stellettæ.'

"*a*. Cortex thin or next to nothing, charged more or less with minute stellates only (Stellifera).

"*b*. Cortex similar, but charged with bacilliform bodies chiefly (Bacillifera).

"Subsection II. Pycnodermata:—'Thick-skinned Stellettæ.'

"*a*. Cortex thick, charged with discoid bodies (Discifera).

"*b*. Cortex thick, charged with globostellates (Globostellata)."

No illustrative species of Stellifera are given; of Bacillifera, *Ecionema acervus*, Bwk., *Ecionema densus*, Bwk., *Ecionema ponderosus* (=*Stryphnus ponderosus*), Bwk., and *Stelletta helleri*, O. S., are quoted; of Discifera, *Stelletta euastrum*, O. S., *Stelletta discophora*, O. S., *Stelletta mamillaris*, O. S.; and of Globostellata, two new species, *Stelletta reticulata*, Crtr., and *Stelletta globostellata*, Crtr.

Notwithstanding its want of completeness this arrangement has a good deal to recommend it; a particularly good distinction is the primary one into Psilodermata and Pycnodermata. The Stellifera would include our *Myriastra* and *Anthastra*; the Bacillifera the single genus *Ecionema*, Bwk.

The Discifera are equivalent to the genus *Erylus* of the Geodiidæ; the Globostellata to the new genus *Aurora*.

In redistributing the contents of the family, regard has been paid to the general assemblage of characters, and the genera now proposed will, I think, prove to be natural; there are some which are more doubtful than others, on account of their being founded either on single species or on single characters; such are *Astrella*, distinguished from *Stelletta* by possessing but one form of aster; *Anthastra*, distinguished from *Myriastra* by the presence of a second aster (the anthaster). The grouping of the genera into subfamilies depends chiefly on the characters of the asters.

Subfamily 1. Homasterina; Stellettidæ which never possess more than one form of aster.

a. Ectosome not a cortex—*Myriastra*.

b. Ectosome a fibrous cortex—*Pilochrota*, *Astrella*.

In the remaining genera more than one form of aster is present, they may therefore be termed "heterastrose."

Subfamily 2. Euasterina; heterastrose Stellettidæ in which the additional microsclere is a euaster.

a. Ectosome not a cortex—*Anthastra*.

b. Ectosome a fibrous cortex—*Stelletta*, *Dragmastra*.

c. Ectosome crowded with large spherasters, but not fibrous—*Aurora*.

Subfamily 3. Rhabdasterina; heterastrose Stellettidæ in which the additional microsclere is a microrabd.

a. Ectosome not a cortex—*Ecionema*.

b. Ectosome a fibrous cortex—*Psammastra*.

c. Ectosome crowded with microrabds—*Papyrula*, *Algol*.

Subfamily 4. Sanidasterina; heterasterose Stellettidæ in which the additional microsclere is a sanidaster or amphiaster.

a. Skeleton radiately arranged, ectosome a fibrous or fibro-spicular cortex—*Ancorina*, *Tribrachium*, *Disyringa*, *Tethyopsis*.

b. Skeleton with no regular arrangement, ectosome a spicular not a fibrous cortex—*Stryphnus*.

Subfamily 1. Homasterina.

Genus 1. *Myriastra*, Sollas.

Myriastra, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 188, 1886.

Sponge small, frequently more or less spherical; oscules distinct; pores in sieves, leading into widely ramifying subdermal cavities. Ectosome thin, collenchymatous. The microsclere is a chiaster.

Type—*Myriastra subtilis* (p. 113).

Genus 2. *Pilochrota*, Sollas.

Pilochrota, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 189, 1886.

Oscules usually distinct; pores in sieves leading into radial incurrent canals which are not constricted on passing through the fibrous layer of the cortex. Ectosome differentiated to form a cortex which usually consists of a middle collenchymatous layer, an outer thinner and an inner thicker fibrous layer. The microsclere is a chiaster.

Type—*Pilochrota haeckeli* (p. 120).

Genus 3. *Astrella*, Sollas.

Astrella, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 191, 1886.

The cortex is usually well developed, consisting of a thick outer layer of collenchyma, sharply defined from a thick inner layer of fibrous tissue; the collenchyma passes into a thin fibrous layer beneath the outer epithelium; pores in sieves. Chones completely differentiated, consisting of a main canal traversing the collenchymatous layer, proximally constricted into a narrow tube which passes through the inner fibrous layer, distally divided into several branches each of which terminates beneath a pore-area. The microsclere is a pycnaster.

Type—*Astrella vosmaeri*, n. sp. (p. 181).

Subfamily 2. Euasterina.

Genus 4. *Anthastra*, Sollas.

Anthastra, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 191, 1886.

Sponge usually more or less spherical; oscules distinct or not; pores in sieves overlying extensive ramifying subdermal cavities. An anthaster is present in addition to a chiaster.

Type—*Anthastra pulchra*, n. sp. (p. 183).

Genus 5. *Stelletta* (O. Schmidt).

Stelletta, O. Schmidt, Spong. Adriat. Meeres, p. 46, 1862.
„ Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 192, 1886.

Oscules distinct or not; pores in sieves overlying completely differentiated chones. Cortex well developed, similar in structure to that of *Astrella*. Of the two forms of aster which are present, one is generally distributed throughout the Sponge (somal), the other is restricted to the choanosome (choanosomal).

Type—*Stelletta boglicii*, O. Schmidt (p. 184).

Genus 6. *Dragmastra*, Sollas.

Dragmastra, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 193, 1886.

Sponge similar to *Stelletta*, but with the collenchymatous layer of the cortex crowded with orthodragmas.

Type—*Dragmastra normani*, Sollas (p. 187).

Genus 7. *Aurora*, n. gen.

The cortex is not differentiated into two layers; densely crowded with large spherasters.

Type—*Aurora globostellata* (Carter) (p. 187).

Subfamily 3. Sanidasterina.

Genus 8. *Ancorina* (O. Schmidt).

Ancorina, O. Schmidt, Spong. Adriat. Meeres, p. 51, 1862.

The cortex is thick and fibrous, and is not produced into tubular outgrowths. The sanidaster is confined to the ectosome; in addition a somal chiaster or choanosomal oxyaster may be present.

Type—*Ancorina cerebrum*, O. Schmidt (p. 188).

Genus 9. *Tribrachium* (Weltner *emend.* Sollas).

Tribrachium, Weltner, Beiträge z. Kenntniss der Spong., Inaug. Diss. Freiburg, p. 50, 1882.
„ Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 194, 1886.

Sponge spherical, produced into a special cloacal tube, the megascleres of which are orthodiænes. The microscleres are sanidasters only, though a minute euaster may occasionally be present.

Type—*Tribrachium schmidtii*, Weltner (p. 154).

Genus 10. *Tethyopsis*, Stewart.

Tethyopsis, Stewart, Monthly Micr. Journ., N.S. vol. x. p. 281, 1870.

Sponge more or less spherical, produced into a complex cloacal tube, the megascleres of which are anisocladal orthotriænes. The microscleres are an ectosomal spheraster (very minute pycnaster), a choanosomal chiaster, and an orthodragma; sanidasters are absent.

The pores are not distributed over the general surface of the Sponge.

Type—*Tethyopsis columnifera*, Stewart (p. 190).

Genus 11. *Disyringa*, n. gen.

Sponge more or less spherical, produced at one pole into a complex cloacal tube, and at the opposite pole into a simple poriferous tube, to which the pores of the Sponge are confined. The megascleres of the cloacal tube are modified ortho- and dicho-triænes. The microscleres are an ectosomal sanidaster, a choanosomal oxyaster, and an orthodragma.

Type—*Disyringa dissimilis* (Ridley) (p. 161).

Genus 12. *Stryphnus*, Sollas.

Stryphnus, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 193, 1886.

Sponge massive; ectosome consisting of collenchyma densely crowded with megascleres irregularly arranged. The somal megascleres are colossal oxeas, irregularly distributed. The ectosomal megascleres are ortho-, plagio-, or dicho-triænes. The microscleres are some form of euaster and an irregular sanidaster or amphiaster.

Type—*Stryphnus niger*, Sollas (p. 171).

Subfamily 4. Rhabdasterina.

Genus 13. *Ecionema* (Bowerbank).

Ecionema, Bowerbank, Mon. Brit. Spong., vol. i. p. 173, 1864.

The ectosome does not form a cortex. A microrabd is present in addition to a euaster.

Type—*Ecionema acervus*, Bowerbank (p. 196).

Genus 14. *Papyrula*, O. Schmidt.

Papyrula, O. Schmidt, Spong. Küste v. Algiers, p. 18, 1868.

The macrosclères are a euaster and a microrabd. The ectosome is thin and densely crowded with microxeas.

Type—*Papyrula conduplicata*, O. Schmidt (p. 199).

Genus 15. *Psammastra*, Sollas.

Psammastra, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 194, 1886.

Cortex thick, fibrous, containing embedded foreign bodies; surface conulose. The megasclères include modified plagiotriænes. In addition to euasters a microrabd is present.

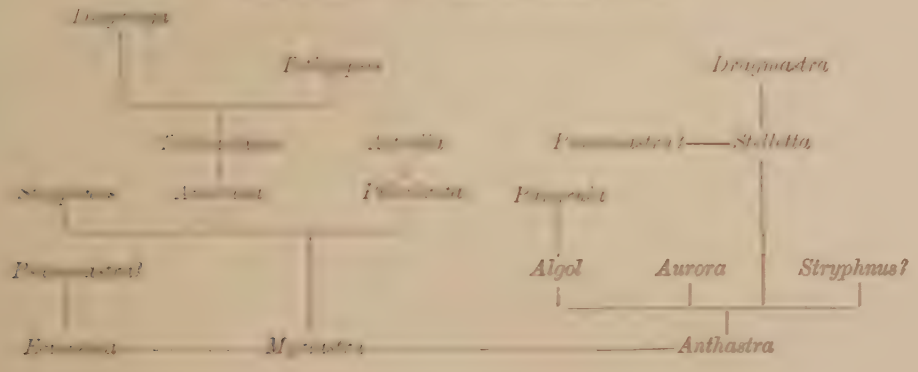
Type—*Psammastra murrayi*, Sollas (p. 175).

Genus 16. *Algol*, n. gen.

The ectosome is thin, not fibrous, and contains tangentially scattered oxeas. The macrosclères are a thaster and a comparatively large microrabd. The megasclères are partly radially and partly irregularly arranged.

Type—*Algol corrugata* (Carter) (p. 200).

Phylogeny of the Stellettidæ.



Appendix to the Euastrosa.

Family Epipolasidæ.

Euastrosa (?) without triænes, possessing oxeas and one or more forms of aster. The oxeas arranged partly in radiating fibres, partly scattered loosely in the choanosome; in the ectosome disposed tangentially. The chamber-system (so far as investigated) aphodal.

Genus 1. *Amphius*, n. gen.

Epipolasidæ possessing but one form of microsclere, an amphiaster. Chamber-system diplodal.

Type—*Amphius huxleyi*, n. sp. (p. 178).

Genus 2. *Asteropus*, n. gen.

Epipolasidæ resembling *Stryphnus*, from which they differ mainly by the absence of a triæne. Chamber-system (?).

Type—*Asteropus simplex* (Carter), p. 205.

Genus 3. *Coppatias*, n. gen.

Epipolasidæ in which the single form of microsclere is a euaster. Chamber-system (?).

Type—*Coppatias coriaceus* (Carter), p. 207.

The position of this family is altogether doubtful: the genus *Amphius* certainly presents great resemblance to the Stellettidæ so far as its soft tissues are concerned, and the chamber-system might with almost as much justice be termed aphodal as diplodal; of the soft parts of the other two genera nothing is known; *Asteropus* in the character and arrangement of its spicules, at least in *Asteropus simplex*, so closely resembles *Algol corticata*, with which it was associated by Carter in the genus *Stellettinopsis*, that I am strongly of opinion some close phylogenetic connection exists between the two, and indeed that *Asteropus* has resulted from an *Algol* by the loss of triænes. Of *Coppatias* I am not in a position to speak, as I have seen no specimens of it, but I am inclined to think that its place will eventually be found to lie somewhere within the Spintharophorous division of the Monaxonids.

Demus III. Sterrastrosa, Sollas.

Sterrastrosa, Sollas, Encyclopædia Britannica, vol. xxii. p. 423, 1887.

Astrophora in which the characteristic microsclere is a sterraster.

Family I. Geodiidæ, Gray.

Geodiadæ, Gray, Proc. Zool. Soc. Lond., pp. 127, 492, 1867.
Geodinidæ, O. Schmidt, Spong. Atlant. Gebiet., p. 68, 1870.
Geodina, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xvi. p. 66, 1875.
Geodidæ, Vosmaer, Bronn's Klass. u. Ord. d. Thierreichs, Porifera, p. 315, 1887.

History.—The earliest described Choristid Sponge (*Cydonium mulleri*, Fleming) belongs to this family; it was faithfully figured by Donati in 1750. The genus which has given its name to the family is *Geodia*, Lamarck, of which Lamarck described a single species, *Geodia gibberosa*.[1] In his earliest work O. Schmidt[2] included the genus *Geodia* with the Corticata, but when this group was dissolved a family Geodiadæ was formed to receive the Geodine Sponges, this family and the Ancorinidæ together including all the Choristid Sponges known to O. Schmidt. Gray, however, had previously proposed a family Geodiadæ which only differed from that of Schmidt by the exclusion of the genus *Placospongia*, Gray, for which a special family, the Placospongiadæ, was instituted. Although Schmidt gives an account of *Placospongia* in his description of Atlantic Sponges, I do not think he can have had a very intimate acquaintance with it, or he would scarcely have laid so much stress on the supposed absence of triænes in *Caminus* when the case was so much clearer in *Placospongia*, which is not only devoid of triænes but of oxeas as well, these spicules being replaced by tylostyles; perhaps a still more remarkable feature in this Sponge is the replacement of euasters by spirasters; Gray being well aware of these facts, was fully justified in excluding *Placospongia* from the Geodiidæ.

Gray's classification of the Sterrastrosa shows great insight and judgment. Omitting the definitions, which are not felicitous, it is as follows:—

Family I. Geodiadæ.

Genus 1. *Pachymatisma*, Bwk.—*Pachymatisma johnstonia*, Bwk.
2. *Geodia*, Lamk.—*Geodia gibberosa*, Lamk.
3. *Cydonium*, Fleming—Gray wrongly quotes *Cydonium barretti*, Bwk. (which is a *Geodia*), as an example, the type is *Cydonium mulleri*, Fleming.
4. *Erylus*, Gray—*Erylus mammillaris*, O. Schmidt.
5. *Triate*, Gray—*Triate discophora*, O. Schmidt.
6. *Caminus*, O. Schmidt—*Caminus vulcani*, O. Schmidt.

Family II. Placospongiadæ.

Genus 1. *Placospongia*, Gray—*Placospongia melobesiodes*, Gray.

[1] Lamarck, *Mém. Mus. Hist. Nat. Paris*, t. i. p. 333, 1815.
[2] O. Schmidt, Spong. Adriat. Meeres, p. 49, 1862.

Gray's modification of this classification in 1872 is by no means an improvement, but notwithstanding numerous alterations the distinctness of the Placospongiadæ from the Geodiadæ is maintained.[1]

Carter in 1875 (*loc. cit.*) regarded the Geodiidæ as a subfamily group of equal value to the Stellettidæ and Tethyina (our Tetillidæ), these three groups together constituting the family Pachytragidæ, Carter. The genus *Placospongia* was removed from all association with the Geodiidæ and placed in the subfamily Donatina, Carter, belonging to the Suberitidæ. In 1880[2] I adopted Carter's group Geodina, but included in it *Placospongia*, a Sponge which I probably had not then seen, and was clearly not well acquainted with. In the same year Carter[3] justified the association of *Placospongia* with the Suberitidæ on the ground that it possesses tylostyles and spirasters; subsequently Carter[4] proposed a new group, Placospongina = Placospongiadæ, Gray, adding that "in spiculation" it unites the two groups "Suberites" and Geodina. Vosmaer does not include *Placospongia* in the Geodiidæ, nor indeed does it find a place in his system.

Definition.—Sterrastrosa possessing triæne megascleres.

The characters of the cortex, which is the most distinctive feature of the Sterrastrosa, have been most closely studied in the Geodiidæ. The sterrasters are united together by fusiform fibrillated cells, probably inocytes, which are attached to the projecting ends of the actines, and these are frequently furnished with recurved spines to afford a surface of attachment: the connecting cells extend directly in a straight line from the surface of one sterraster to the opposed faces of its surrounding neighbours, and thus a strong, tough, composite sclerose and fibrous layer results, which we shall term the "sterrastral layer." It is a unique feature in the Sponges, nothing quite similar to it occurring in any of the other groups; in some cases, as in *Disyringa* for example, oxeas tangentially arranged are bound together by fibrous tissue in the cortex, but the union is produced by the fibres wrapping round the united spicules; a somewhat similar spicular layer also occurs in *Dragmastra*, which is characterised by a dragmastral layer of the cortex, but the dragmas in this case lie in clusters in a collenchymatous layer, and are not in organic connection with it; in another Stellettid genus, *Aurora*, a sclerose layer, in this case spherastral, occurs, but so far as one can conclude from an examination of dried specimens, there is just as little organic union of the scleres here as in *Dragmastra*; in *Craniella* and *Cinachyra* a composite layer of oxeas and fibrous tissue occurs, but without presenting any such union as occurs in the Geodiidæ; finally, in the Monaxonid *Tethya* the cortex is characterised by spherasters embedded in fibrous tissue, but though I have sought carefully for some signs of a direct connection between the scleres and the fibres, I have never been able to find any.

[1] Gray, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. ix. p. 460, 1872.
[2] Sollas, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. v. p. 241, 1880.
[3] Carter, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vi. p. 55, 1880.
[4] Carter, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ix. p. 357, 1882.

In one genus of the Geodiidæ, viz., *Erylus*, which belongs to the subfamily Erylina, the sterrasters, in addition to presenting a different form to those of the rest of the family, differ also in their mode of union: the fibrillated inocytes which bind them together are attached to their surface, but do not appear to take a direct course from one sclere to the other; so far as I can make out they wrap round them instead.

On the inner face of the sterrastral layer is a layer of fibrous tissue in which the fusiform cells are tangentially arranged; this, which differs in thickness in different species, will be spoken of as the "inner fibrous layer"; it and the sterrastral layer together are probably homologous with the fibrous layer of the Stellettid cortex.

On the outer face of the sterrastral layer, between it and the outer epithelium, is a layer of tissue, which differs in thickness and character with the species, occasionally it is collenchymatous, but usually cystenchymatous; it will be termed the "ectochrote." A layer of microscleres (sonal) invariably occurs in the ectochrote immediately below the outer epithelium, and these spicules remain to indicate it in those cases where it is so much reduced that but for them it would naturally be set down as absent. In one case, *Cydonium glariosus*, it contains numerous embedded grains of sand.

The existence of the sterrastral layer gives great definiteness to the chones, which traverse it usually as wide, simple, more or less cylindrical canals, closed at the inner end by a very evident sphincter; at the outer end they may either open directly to the exterior by a simple large pore (uniporal chones), or break up into numerous ramifying canals, or extend into wide subdermal sinuses, within the ectochrote, and then open to the exterior by many pores with a sieve-like arrangement (cribriporal chones).

The excurrent canal-system opens to the exterior in very various ways, in some cases by chones not differing in character from those of the incurrent system, so that, as well as incurrent, we may have excurrent uniporal or cribriporal chones; in other cases different arrangements prevail, thus in *Pachymatisma* the oscule is the opening of a large chone which leads through the sphincter into a subcortical chamber, in which several large excurrent canals open by non-sphinctrate apertures, this structure may be regarded as an overgrown uniporal chone; in *Erylus* and *Caminus* the oscule is the opening of a large cloaca which receives the excurrent canals by non-sphinctrate openings, this may be regarded as an overgrown uniporal chone without a sphincter, and in connection with this we may notice that the incurrent chones in these genera do not appear to be sphinctrate either; finally, in *Geodia* the oscule leads into a cloaca, into which numerous large excurrent canals open, each provided with a special sphincter, this structure we may suppose has been produced by the overgrowth of the centripetal end of a uniporal chone and the multiplication of its sphincters. It must not be supposed, however, that the cloacal structure of *Geodia* has been actually produced in this way, in all probability it arises in the manner explained on p. xxxi *et seq.*

It is on the characters of the excurrent and incurrent openings taken together that

the generic distinctions of the group depend, these will be best understood by reference to the accompanying diagrams (Fig. XIV.).

Skeleton.—The general arrangement of the megascleres is radial, but to this there are several exceptions, at least in the adult state, for it is probable that in the very young state all the Geodiid species are radiate.

The most marked exceptions among adult Sponges are met with in *Erylus*, *Caminus*, and *Pachymatisma*; in the last named the oxeas are scattered without any trace of order

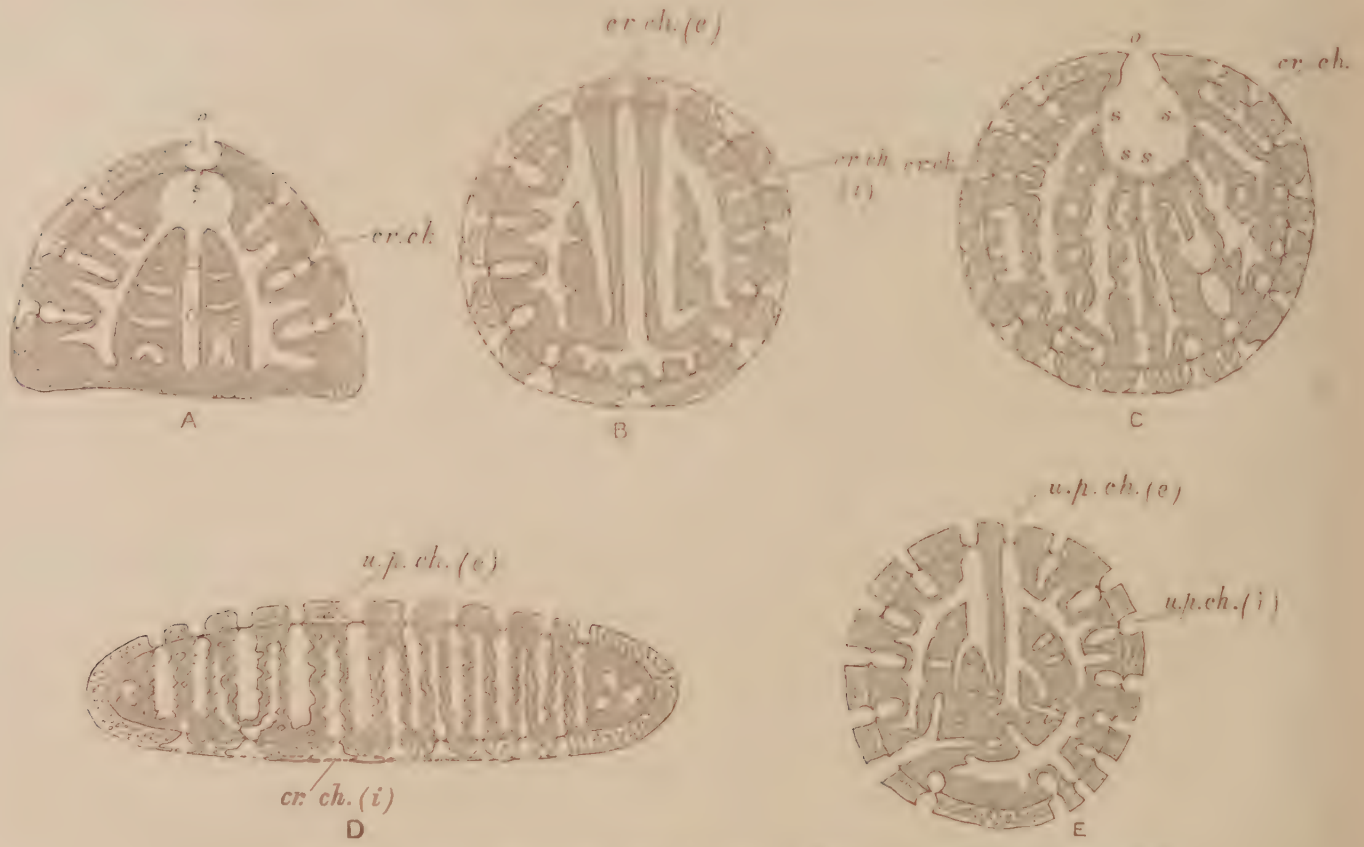


Fig. XIV.—Diagrams of the canal system as distinctive of the genera of Geodiidæ. A, *Pachymatisma*; B, *Cydonium*; C, *Geodia*; D, *Synops*; E, *Isops*; *cr.ch.*, cribriporal chones; *u.p.ch.*, uniporal chones; *o.*, oscule; (*i*) incurrent, (*e*) excurrent; *s*, sphincter.

through the Sponge, but the triænes, which are as a rule confined to the neighbourhood of the cortex, are radially disposed; in *Erylus* the arrangement is essentially the same, and it is very similar in *Caminus*, the chief difference lying in the more general aggregation of the oxeas into fibres, which are directed radially near the cortex, but wander without any definite direction elsewhere. In both *Caminus* and *Pachymatisma* the oxeas are frequently cemented together by spongin.

In all species the triænes usually lie with their cladi extended facially immediately beneath the sterrastral layer of the cortex; sometimes but rarely the cladi enter this layer and are then liable to deformations, more often both triænes and rhabdi pass through and project beyond the cortex, hispidating the surface. A second finer hispidation is frequently produced by small oxeas, which are confined to the cortex (cortical oxeas). Associated with these in some few instances are minute anatriænes, which much remind one of the cladose tylostyles described by Dendy and Ridley in *Proteleia sollasi*.

Genital Products.—Spermatozoa, but not ova, have been observed; for an account of the former see *Caminus* (p. 216).

Development.—The earliest form of *Geodia* which I have seen is a small Sponge, almost spherical, measuring 1·6 and 1·27 mm. along its polar and equatorial diameters: it occurred among the hispidating spicules of a specimen of *Rhaphidothecu marshall-halli*, S. Kent, belonging to the Rev. A. M. Norman's collection of Norwegian Sponges. Comparatively large as this specimen is, it yet presents points of difference from the parent Sponge of considerable interest: the ectosome is scarcely advanced beyond the stage of *Thenea muricata*, certainly not beyond that of *Myriastra*; a thin membrane covers extensive subdermal cavities, just as described in the case of *Stelletta phrissens*, and chones are absent; just above and bulging out the lower face of the dermal membrane is a single layer of sterrasters; these lie more remote from one another than in the adult, but are united together by bundles of granular fusiform cells in precisely the same fashion: the sterrastral layer develops, therefore, in what corresponds to the roof of subdermal cavities, and thus we meet with confirmation almost amounting to proof of the conclusion arrived at in the case of *Stelletta phrissens*, *viz.*, that in some cases the cortex is a highly developed dermal membrane and the chones centrifugal extensions of the subdermal cavities.

The Geodiidæ may be classified as follows:—

Subfamily 1. Erylina.

The megascleres are orthotriænes and rhabdi; anatriænes and protriænes are absent. The somal microsclere is a diactinate aster or spherule.

Genus 1. *Erylus*, Gray.

Erylus, Gray, Proc. Zool. Soc. Lond., p. 549, 1867.
Triate, Gray, Proc. Zool. Soc. Lond., p. 549, 1867.

The sterraster is seldom spherical; the somal microsclere is a centrotylote microrabdus. The incurrent chones are uniporal, and the oscule is the patent opening of a cloaca.

Type—*Erylus mammillaris* (O. Schmidt) (p. 238).

Genus 2. *Caminus*, O. Schmidt.

Caminus, O. Schmidt, Spong. Adriat. Meeres, p. 48, 1862.

The sterraster is seldom spherical; the somal microsclere is a spherule. The roofs of the incurrent chones are cribriporal, and the oscule is the patent opening of a cloaca.

Type—*Caminus vulcani*, O. Schmidt (p. 241).

Genus 3. *Pachymatisma*, Bowerbank.

Pachymatisma, Bowerbank, Mon. Brit. Spong., vol. ii. p. 3, 1866.

The sterraster is subspherical or ellipsoidal; the somal microsclere is a microstrongyle. The roofs of the incurrent chones are cribriporal, and the oscules are the single openings of cloacal chones, which each lead into a large cavity beneath the chonal sphincter (Fig. XIV., A).

Type—*Pachymatisma johnstonia*, Bowerbank (p. 242).

Subfamily 2. Geodina.

The megascleres are rhabdi, ortho-, or dichotriænes, and frequently in addition pro- and anatriænes. The sterraster is spherical or ellipsoidal; the somal microsclere is a polyactinose aster.

Genus 4. *Cydonium* (Fleming).

Cydonium, Fleming, History of British Animals, p. 516, 1828.
,, Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 243.

The incurrent chones are furnished with cribriporal roofs; the oscules are sometimes uniporal, but more usually cribriporal, openings of excurrent chones which resemble the incurrent chones (Fig. XIV., B), but are usually collected in special areas without definite margins.

Type—*Cydonium mulleri*, Fleming (p. 254).

Genus 5. *Geodia* (Lamarck).

Geodia, Lamarck, Mém. Mus. Hist. Nat. Paris, vol. i. p. 333, 1815.
Pyxitis, O. Schmidt, Spong. Atlant. Gebiet., p. 70, 1870.
Geodia, Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 245, 1880.
,, Vosmaer, Bronn's Klass. u. Ord. d. Thierreichs, Porifera, p. 317, 1887.

The incurrent chones are furnished with cribriporal roofs. In the young Sponge the oscule is the patent opening of a cloaca, into which the excurrent canals open by

sphinctrate apertures (Fig. XIV., c); in the adult the cloaca may persist or become converted into a shallow depression, which is usually surrounded by a more or less sharply defined margin.

Type—*Geodia gibberosa*, Lamarck (p. 244).

Genus 6. *Synops*, Vosmaer.

Synops, Vosmaer, Niederl. Archiv f. Zool., Suppl. i. p. 50, 1882.

The poriferous and ocular surfaces are distinct. Oscules the single openings of excurrent chones; incurrent chones with cribriporal roofs (Fig. XIV., D)

Type—*Synops pyriformis*, Vosmaer (p. 266).

Genus 7. *Isops*, Sollas.

Isops, Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 396, 1880.

Oscules and pores similar, both the simple apertures of similar uniporal chones (Fig. XIV., E).

Type—*Isops phlegræi*, Sollas (p. 267).

Subdivision of the Genera of the Geodinæ.—The species of *Geodia* and *Cydonium* are so numerous that, for purposes of convenience, they are artificially grouped in sections determined by the number of different kinds of spicules they possess; these sections are as follows:—

Section 1. *Pantæosa*, species with both somal and cortical oxeas, and anatriænes or protriænes or both, in addition to orthotriænes or dichotriænes.

Section 2. *Dirabdosa*, species with both cortical and somal oxeas, but without either anatriænes or protriænes.

Section 3. *Ditriæna*, species without cortical oxeas, but with anatriænes or protriænes or both, in addition to orthotriænes or dichotriænes.

Section 4. *Monotriæna*, species with but one form of oxea and but one form of triæne, which is never either an anatriæne or a protriæne.

Family II. Placospongidæ, Gray.

Placospongiadæ, Gray, Proc. Zool. Soc. Lond., p. 549, 1867.
Placospongina, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 55, 1880.
Placospongidæ, Sollas, Encyclopædia Britannica, vol. xxii. p. 423, 1887.

Sterrastrosa not possessing triæne spicules; the only megascleres are tylostyles. The sterrastral layer of the cortex is subdivided into irregular or polygonal plates, which are united together by fibrous tissue.

Genus 1. *Placospongia*, Gray.

Placospongia, Gray, Proc. Zool. Soc. Lond., pp. 127-129, 1867.

The only genus of the family.

Type—*Placospongia melobesioides*, Gray (p. 271).

That no little doubt should exist with regard to the systematic position of this remarkable family is only natural. Tylostyles do not occur as essential spicules in any other Tetractinellid Sponge, while they are characteristic of the monaxonid family Suberitidæ; there is something, therefore, especially as triænes are absent, to be said for Carter's view, according to which they should be placed with the last-named family. The tylostyle is not, however, so characteristic and differentiated a spicule as the sterraster, hence I prefer to follow Gray in grouping the family with the Geodiidæ.

Suborder III. MICROSCLEROPHORA, Sollas.

Tetradina, Sollas (*pars*), Sci. Proc. Roy. Dubl. Soc., vol. v. p. 177, 1886.
Microsclerophora, Sollas, Article "Sponges," Encyclopædia Britannica, vol. xxii. p. 423, 1887.

Choristida in which megascleres are absent; the characteristic microscleres are either tetractinose asters, candelabra, or minute triænes.

In my preliminary report the Tetradina formed the first suborder of the Choristida, and included the Pachastrellidæ; on the removal of this family to the Streptastrosa, with which it should evidently be associated, the Tetradina ceases to be a distinctive name, but the essential character of the group, as one in which the microscleres have not yet given rise to megascleres, is brought into prominence; hence the change in name and definition.

Family I. Placinidæ, F. E. Schulze.

Plakinidæ, F. E. Schulze, Zeitschr. f. wiss. Zool., Bd. xxxv. p. 407, 1880.

Microsclerophora with tetractinose, triactinose, and diactinose asters, and sometimes mono-, di-, or trilophous candelabra. The chamber-system is either eurypylous or aphodal; the mesoderm chiefly collenchymatous. The Sponge is divided into a hypomere and spongomere.

Genus 1. *Placina*, F. E. Schulze.

Plakina, F. E. Schulze, Zeitschr. f. wiss. Zool., Bd. xxxiv. p. 448, 1880.

Incrusting Sponges, with one or more oscular tubes projecting from the free surface. Ectosome not differentiated. Chamber-system eurypylous. Mesoderm scanty, entirely

collenchymatous. The spicules are tetractinose, triactinose, and diactinose asters, and candelabra.

Type—*Placina monolopha*, F. E. Schulze (p. 278).

Genus 2. *Placortis*, F. E. Schulze.

Plakortis, F. E. Schulze, Zeitschr. f. wiss. Zool., Bd. xxxiv. p. 449, 1880.

Incrusting Sponges, provided with an ecto-ome, which is traversed by a network of widely extending subdermal cavities. The chamber-system is aphodal, with wide short aphods. The choanosomal mesoderm is a granular collenchyma. The spicules are tri- and di-actinose asters; candelabra are not present.

Type—*Placortis simplex*, F. E. Schulze (p. 279).

Family II. Corticidæ, Vosmaer.

Corticata, Vosmaer, Lenas & Klein s. Ord. d. Thierreichs, Porifera, p. 324, 1885.
„ Sollas (*pars*), Sci. Proc. Roy. Dubl. Soc., vol. v. p. 177, 1886.
„ Sollas, Art. "Sponges," Encyclopædia Britannica, vol. xxii. p. 423, 1887.

Microsclerophora with tetractinose asters and candelabra. The chamber-system is aphodal or diplodal. The mesoderm is in part sarcenchymatous, in part chondrenchymatous.

In my preliminary report I included the genus *Thrombus* in the Corticidæ; on account of the distinctive characters of its spicules it is now removed thence and made the type of a separate family.

Genus 1. *Corticium*, O. Schmidt.

Corticium, O. Schmidt, Spong. Adriat. Meeres, p. 42, 1862.
„ F. E. Schulze, Zeitschr. f. wiss. Zool., Bd. xxxv. p. 410, 1881.

The mesoderm of the ectosome and hypomere consists of chondrenchyme, which also forms the walls of the larger water-canals. The spicules are tetractinose asters and heterolophous candelabras.

Type—*Corticium candelabrum*, O. Schmidt (p. 280).

Genus 2. *Calcabrina*, n. gen.

Corticidæ containing spinose microrabds in addition to tetractinose asters or candelabra.

Type—*Calcabrina plicata* (O. Schmidt) (p. 281).

Genus 3. *Corticella*, n. gen.

Corticidæ containing polyactinose in addition to tetractinose asters.
Type—*Corticella stelligera* (O. Schmidt) (p. 281).

Genus 4. *Rhachella*, n. gen.

Corticidæ (?) characterised by polycladose calthrops.
Type—*Rhachella complicata* (Carter) (p. 281).

Family III. Thrombidæ, Sollas.

Thrombidæ, Sollas, Encyclopædia Britannica, vol. xxii. p. 428, 1887.

Microsclerophora with trichodragmes, and sometimes a peculiar form of amphiaster. The ectosome is thin and not sharply defined from the choanosome. The mesoderm is a dense collenchyma, containing numerous large granular cells in addition to collencytes. The chamber-system is diplodal.

Genus 1. *Thrombus*, Sollas.

Thrombus, Sollas, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 179, 1886.

With the characters of the family.
Type—*Thrombus challengeri*, Sollas (p. 275).

Great interest attaches to the suborder Microsclerophora: the family Placinidæ evidently lies near the root of the Tetractinellida and of the Spintharophorous Monaxonida also, while it is not separated by a very wide interval from the still more primitive Myxospongiæ; were *Oscarella lobularis* to acquire tetractinose asters it would of necessity be included in the Placinidæ. The fact that in my preliminary report I included in the Placinidæ the new genus *Epallax*, which on fuller consideration I now assign to the Axinellidæ, shows how nearly these families are related, and how closely the Spintharophora and Tetractinellida approach each other.

Order II. LITHISTIDA, O. Schmidt.

Lithistidæ, O. Schmidt, Spong. Atlant. Gebiet., p. 21, 1870.
„ Carter, Ann. and Mag. Nat. Hist., ser. 4. vol. xii. p. 437, 1873.
Subfamily *Lithistina*, Carter, *op. cit.*, ser. 4, vol. xvi. p. 185, 1875.
Order *Lithistidæ*, Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 67, 1878.
Suborder *Lithistina*, Vosmaer, Bronn's Klass. u. Ord. d. Thierreichs, Porifera, Bd. ii. p. 281, 1887

Tetractinellida provided with a consistent skeleton by the zygosis of modified spicules or desmas.

Suborder I. HOPLOPHORA.

Lithistida provided with special ectosomal spicules, and usually with some form of microsclere.

Demus I. Triænosa.

Hoplophora in which the ectosomal spicules are some form of triæne, and in which microscleres (spirasters, amphiasters, or microrabds) are invariably present. The chamber-system is aphodal.

Family I. Tetracladidæ (Zittel).

Tetracladina, Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 100.

Triænosa in which the desma is tetracrepid.

Genus 1. *Theonella*, Gray.

Theonella, Gray, Proc. Zool. Soc. Lond., p. 438, 1868.
„ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 103, 151, 1878.

Tetracladidæ with one or more simple oscules, pores in sieves generally distributed. Microsclere a microstrongyle.

Type—*Theonella swinhoei*, Gray (p. 284).

Genus 2. *Discodermia*, Bocage.

Discodermia, Bocage, Journ. d. sc. math. phys. et nat. Lisbonne, p. 160, pl. xi. fig. 1, 1869.
„ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 151, 1878.

Tetracladidæ with differentiated ocular and poriferous surfaces; the pores in sieves, the oscules numerous and simple. The microscleres are microxeas and microstrongyles.

Type—*Discodermia polydiscus*, Bocage (p. 330).

Genus 3. *Racodiscula*, Zittel.

Racodiscula, Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 151, 1878.

Tetracladidæ with discotriænes; the microscleres are microrabds and spirasters; the pores and oscules are simple.

Type—*Racodiscula polydiscus* (O. Schmidt) (p. 332).

Genus 4. *Kaliapsis*, Bowerbank.

Kaliapsis, Bowerbank, Proc. Zool. Soc. Lond., pp. 76, 337, 1869.

Tetracladidæ which occur as thin incrusting plates, having the desmas of the base peculiarly modified; the discotriænes are tuberculated on the outer surface. The microsclere is a microstrongyle.

Type—*Kaliapsis cidaris*, Bowerbank (p. 334).

Genus 5. *Neosiphonia*, n. gen.

Tetracladidæ with a more or less ovate body supported on a longer or shorter stem; canal-system as in the fossil genus *Siphonia*. The ectosomal megascleres are dicho- or trichotriænes. The microsclere is a spiraster (?).

Type—*Neosiphonia superstes*, n. sp. (p. 299).

Genus 6. *Rimella*, O. Schmidt.

Rimella, O. Schmidt, Spong. Meerb. Mexico, p. 21, 1879.

This genus is founded on dead specimens of a single species.

Type—*Rimella clava*, O. Schmidt (p. 335).

Genus 7. *Collinella*, O. Schmidt.

Collinella, O. Schmidt, Spong. Meerb. Mexico, p. 21, 1879.

This genus is founded on dead skeletons of a single species.

Type—*Collinella inscripta*, O. Schmidt (p. 336).

Genus 8. *Sulcastrella*, O. Schmidt.

Sulcastrella, O. Schmidt, Spong. Meerb. Mexico, p. 27, 1879.

This genus is founded on a single species, the characters of which are very insufficiently given by Schmidt.

Type—*Sulcastrella clausa*, O. Schmidt (p. 337).

Family II. Corallistidæ.

Rhizomorina (*pars*), Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 97, 1873.
Megamorinidæ (*pars*), Sollas, Encyclopædia Britannica, vol. xxii. p. 424, 1887.

Triænosa in which the desma is monocrepid and tuberculate. Chamber-system aphodal.

Genus 1. *Corallistes*, O. Schmidt.

Corallistes, O. Schmidt, Spong. Atlant. Gebiet., p. 22, 1870.
„ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 120, 1878.

Corallistidæ in which the ectosomal spicule is a dichotriæne, and the microsclere a spiraster. The pores and oscules are simple.

Type—*Corallistes typus*, O. Schmidt (p. 301).

Genus 2. *Macandrewia*, Gray.

Macandrewia, Gray, Proc. Zool. Soc. Lond., p. 438, 1859.
Dactylocalyx (*pars*), Bowerbank, Proc. Zool. Soc. Lond., p. 86, 1869.
Macandrewia, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. pp. 438, 441, 1873.

Corallistidæ in which the epirabd of the desma is smooth, zygosis is chiefly terminal; the ectosomal spicules are phyllotriænes, and the microsclere a microrabd. The pores and oscules are simple.

Type—*Macandrewia azorica*, Gray (p. 340).

Genus 3. *Dædalopelta*, n. gen.

Corallistidæ in which the desma and discotriæne are similar to those of *Macandrewia* but the microscleres are spirasters.

Type—*Dædalopelta nodosa* (O. Schmidt) (p. 342).

Genus 4. *Heterophymia*, Pomel.

Heterophymia, Pomel, Pal. de l'Oran, p. 143, 1872.
„ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 121, 1878.
Dactylocalyx (*p.p.*), Bowerbank, Proc. Zool. Soc. Lond., p. 85, 1869.

Corallistidæ with separate poriferous and oscular surfaces which are distinguished by different ectosomal spicules, dichotriænes occurring on the poriferous, and small, smooth, irregularly branched desmas on the oscular surface.

Type—*Heterophymia heteroformis* (Bowerbank) (p. 343).

Genus 5. *Callipelta*, n. gen.

Corallistidæ in which the ectosomal spicule has the form of a discotriæne, but the axis of a rhabdus. The microsclere is an amphiaster.

Type—*Callipelta ornata*, n. sp. (p. 309).

Family III. Pleromidæ.

Megamorina, Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 99, 1878.
Megamorinidæ, Vosmaer, Bronn's Klass. u. Ord. d. Thierreichs, Porifera, p. 295, 1886.
„ (*pars*), Sollas, Encyclopædia Britannica, vol. xxii. p. 424, 1887.

Triænosa in which the desma is monocrepid and smooth, not tuberculated; zygosis occurs between the ends of the cladi of one desma and the epirabd of another. Chamber-system aphodal.

Genus 1. *Pleroma*, n. gen.

Pleromidæ in which the flagellated chambers are large, with wide short aphodi. The microscleres are microxeas and spirasters.

Type—*Pleroma turbinatum*, n. sp. (p. 312).

Genus 2. *Lyidium*, O. Schmidt.

Lyidium, O. Schmidt, Spong. Atlant. Gebiet., p. 84, 1870.
„ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 99, 132, 1878.

"Sponge dish-shaped, on both sides simple canals open by large round ostia. [Desma] smooth, crooked, branched, the branches terminating in a disciform, or cup-shaped expansion. In the sarcode of the surface numerous simple [strongyles] of considerable size occur."—(Zittel).

Type—*Lyidium torquilla*, O. Schmidt (p. 343).

Demus II. Rhabdosa.

Hoplophora in which the ectosomal spicules are microstrongyles, or modified microstrongyles (discs). The desmas are monocrepid.

Family I. Neopeltidæ.

Rhabdosa in which the ectosomal spicules are monocrepid discs.

Genus 1. *Neopelta*, O. Schmidt.

Neopelta, O. Schmidt, Spong. Meerb. Mexico, p. 88, 1880.

Neopeltidæ in which the microscleres are microrabds and spirasters.

Type—*Neopelta perfecta*, O. Schmidt (p. 344).

Family II. Scleritodermidæ.

Rhabdosa in which the ectosomal spicules are microstrongyles, and the other microscleres sigmaspires.

Genus 1. *Scleritoderma*, O. Schmidt.

Scleritoderma, O. Schmidt, Spong. Meerb. Mexico, p. 28, 1879.

Scleritodermidæ of plate-like form, bearing simple pores on one face and simple oscules on the other.

Type—*Scleritoderma packardi*, O. Schmidt (p. 346).

Genus 2. *Aciculites*, O. Schmidt.

Aciculites, O. Schmidt, Spong. Meerb. Mexico, p. 29, 1879.

Scleritodermidæ in which the ectosomal spicules are rhabdi; microscleres are absent.

Type—*Aciculites higginsii*, O. Schmidt (p. 347).

Family III. Cladopeltidæ.

Rhabdosa in which the ectosomal spicule is a monocrepid desma highly branched in a plane parallel to the surface. Microscleres are absent.

Genus 1. *Siphonidium*, O. Schmidt.

Leiodermatium, O. Schmidt, Spong. Atlant. Gebiet., p. 21, 1870.
„ . Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 103, 1878.
Siphonidium, O. Schmidt, Spong. Meerb. Mexico, p. 28, 1878.
Leiodermatium, Vosmaer, Bronn's Klass. u. Ord. d. Thierreichs, Porifera, p. 290, 1886.

The oscules are borne at the ends of narrow tubular prolongations extending outwards from the sponge body.

Type—*Siphonidium ramosum*, O. Schmidt (p. 348).

Suborder II. ANOPLIA.

Lithistida in which special ectosomal spicules and microscleres are absent.

Family I. Azoricidæ.

Rhizomorina (*pars*), Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 97, 1878.
Micromorinidæ, Sollas, Spongiæ, Encyclopædia Britannica, vol. xxii. p. 424, 1887.

Anoplia in which the desmas are monocrepid.

Genus 1. *Azorica*, Carter.

Azorica, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 442, 1873.

The pores and oscules are simple, and are borne on opposite surfaces of the plate-like sponge.

Type—*Azorica pfeifferæ*, Carter (p. 319).

Genus 2. *Tretolophus*, n. gen.

Azoricidæ in which the oscules are arranged in a linear series along the summit of a ridge-like elevation. Main excurrent canals more or less vertical.

Type—*Tretolophus paniceus*, n. sp. (p. 325).

Genus 3. *Gastrophanella*, O. Schmidt.

Gastrophanella, O. Schmidt, Spong. Meerb. Mexico, p. 29, 1879.

Azoricidæ in which a single oscule leads into a long axial cloaca; the excurrent and incurrent canals are arranged as in *Siphonia*.

Type—*Gastrophanella implexa*, O. Schmidt (p. 349).

(?) Genus 4. *Setidium*, O. Schmidt.

Setidium, O. Schmidt, Spong. Meerb. Mexico, p. 30, 1879.

Diagnosis not given.

Type—*Setidium obtecum*, O. Schmidt (p. 350).

(?) Genus 5. *Poritella*, O. Schmidt.

Poritella, O. Schmidt, Spong. Meerb. Mexico, p. 27, 1879.

Diagnosis not given by Schmidt; founded on a single dead specimen.

Type—*Poritella decidua*, O. Schmidt (p. 351).

Genus 6. *Amphibleptula*, O. Schmidt.

Amphibleptula, O. Schmidt, Spong. Meerb. Mexico, p. 28, 1879.

Azoricidæ with a single oscule at the summit, and poriferous areas borne at the ends of short cylindrical processes, irregularly and generally distributed over the sides.

Type—*Amphibleptula madrepora*, O. Schmidt (p. 351).

(?) Genus 7. *Tremaulidium*, O. Schmidt.

Tremaulidium, O. Schmidt, Spong. Meerb. Mexico, p. 31, 1879.

Founded on a single species.

Type—*Tremaulidium geminum*, O. Schmidt (p. 352).

Genus 8. *Leiodermatium*, O. Schmidt.

Leiodermatium, O. Schmidt, Spong. Meerb. Mexico, p. 28; Spong. Atlant. Gebiet., p. 22, 1870.
„ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 103, 1878.

Azoricidæ of vasiform shape, with comparatively large oscules situated on the outer surface; pores distributed over the inner surface.

Type—*Leiodermatium lyncurium*, O. Schmidt (p. 352).

Genus 9. *Sympyla*, n. gen.

Azorica (*p.p.*), O. Schmidt, Spong. Meerb. Mexico, p. 89.

Azoricidæ in which the portal terminations of the excurrent canals are collected into separate areas, which are distributed over one side of the sponge; the oscules are simple, and are distributed over the side opposite to that bearing the pores.

Type—*Sympyla cribrifera* (O. Schmidt, p. 353).

Family II. Anomocladidæ, Zittel.

Anomocladina, Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 97, 100, 1878.
„ Sollas, Proc. Roy. Irish Acad., ser. 2, vol. iv. p. 486, 1885.

Anopla in which the desma is acrepid, a variable number of smooth cylindrical cladi radiate from a thickened centrum, zygosis occurs between the expanded ends of the cladi of one desma and the centrum of another.

Genus 1. *Vetulina*, O. Schmidt.

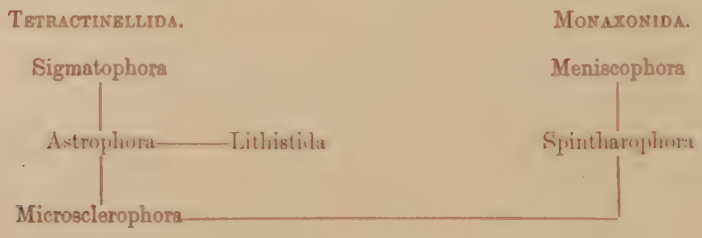
With a single species—*Vetulina stalactites*, O. Schmidt (p. 354).

6. NOTE ON PHYLOGENY.

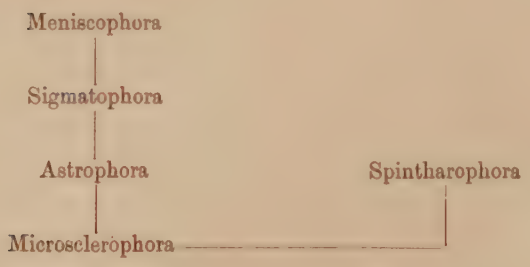
Some remarks on the relationship of the Monaxonida to the Tetractinellida will be found on p. 419.

Of relationships among the Tetractinellida so highly probable that they may almost be regarded as definitely ascertained, a representation is given in the following scheme, in which direction of descent, when this is supposed to be known, is indicated by an arrow, when not by a straight line :—

If we attempt to extend our investigations to the whole of the Tetractinellida and the associated Monaxonida we encounter contending hypotheses, upon the relative merits of which it is at present impossible to decide. Thus if we accept the certainly very tempting hypothesis, that the triæne is descended from a calthrops or a microcalthrops, and the sigmaspire (as analogy in the case of the Lithistida would suggest) from a euaster, then the two most probable schemes of affiliation are the following, first :—



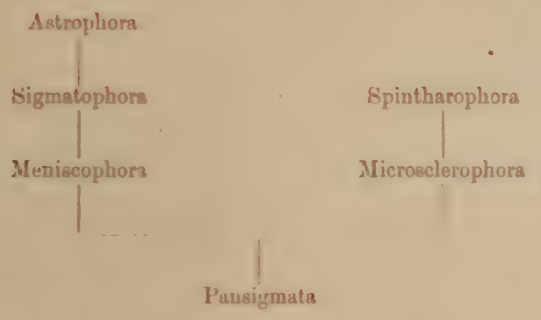
And next :—



These two schemes are not mutually exclusive, for it is possible that the Meniscophora are not a monophyletic group ; part may have been derived from the Sigmatophora and part from the Spintharophora ; and the possibility of a Sigmatophorous origin for a part at least of the Meniscophora is suggested by the frequency with which the triæne

in the Tetillidæ is reduced to a diæne and even a monæne, a fact which on the assumption that the triæne is derived from a calthrops, would lead us to regard it here as a waning form.

If next the weight of evidence should lead us to abandon the assumption just made as to the origin of the triæne and to regard it as descended from a rhabdus, and the sigmaspire from a euaster, then we might construct our phylogeny on the assumption of a hypothetical ancestral family (Pansigmata) in which the skeleton should have consisted wholly of sigmaspires from which rhabdi on the one hand and microtriods and microcalthrops on the other would have been derived; we should then have the following:—



The obvious objection to this scheme is the wide separation it involves between the Microsclerophora and the Astrophora, which we have good reason for believing to be more directly related; and in so far as it is thus rendered improbable, it throws doubts on the assumption on which it is based, *i.e.*, the rhabdal origin of the triæne. On this vexed question it would thus appear that Taxonomy and Ontogeny offer conflicting evidence, but considering how scanty the evidence is, particularly that furnished by Ontogeny, this is no wonder, and with an extension of knowledge a speedy reconciliation is certain.

7. METHODS OF INVESTIGATION.

Preliminary Examination.—The gross anatomy of the Sponge, including the general characters of the ectosome or cortex, of the canal-system, and the forms and disposition of the spicules, is most conveniently investigated by means of thick slices cut free-hand with a razor; these are stained with any rapidly acting dye-stuff,—magenta answers as well as any,—dehydrated with absolute alcohol, cleared with xylol in the usual way, and finally mounted in Canada balsam. By this process, which does not take longer than from five to ten minutes, the generic and usually the specific characters also of nearly all Tetractinellid Sponges can be determined. The flagellated chambers and other minute structures are frequently displayed by this process in the case of such Sponges as possess

a collenchymatous mesoderm, but since it is always necessary to prepare thin slices for the investigation of the finer histological details, but little is gained by this.

Dissociation and teasing must be resorted to for the study of separate histological elements, and the spicules must be isolated from the soft parts for comparison, measurement, and illustration. Under the head of dissociation and teasing I have nothing to add to what is already well known, but with regard to the separation of spicules and the preparation of thin slices, it may prove useful if I describe here in detail those methods which I have found most successful.

Preparation of Thin Slices.—The simplest and most generally useful method is that known as the paraffin process; but sometimes in special cases and for special purposes freezing may be resorted to. Although the hard parts of the Tetractinellida are always siliceous, spongin being the only other substance present in the skeleton in addition to opal, yet it sometimes happens that the sponge contains a considerable quantity of calcium carbonate which has been introduced as foreign matter from without, either during the life of the Sponge or subsequently on being scraped up by the dredge; this calcareous matter is usually in the form of fine mud or consists of isolated tests of Foraminifera and other organisms; frequently also calcareous organisms, more especially Foraminifera, grow attached to the outer surface of the Sponge. As a preliminary to staining all traces of calcium carbonate must be removed. This is best accomplished by an alcoholic solution of nitric acid; a 1 per cent. solution of the acid is made with 60 per cent. alcohol, and this is added to the object placed in 60 per cent. alcohol, drop by drop, till an occasional bubble of gas is set free; the preparation is then left to stand for some hours and a further quantity of acid alcohol added till no more carbon dioxide is liberated, the preparation is then transferred to pure 70 per cent. alcohol, which is changed till every trace of calcium nitrate is extracted. The advantage of this method in avoiding any unnecessary osmosis is sufficiently obvious. Fortunately but few of the Challenger specimens needed to be treated in this manner, but "en revanche" in some few cases other mineral bodies, such as fragments of pumice and grains of quartz sand, were present and there is no process by which these can be removed. My experience of hydrofluoric acid, as might *a priori* have been expected, is altogether unsatisfactory. When siliceous fragments occur lying loosely in the canals of the Sponge the razor will generally tear them out, and fairly satisfactory slices may be obtained, as in the case of *Tetilla sandalina*; but when, as in *Psammastra murrayi*, numerous quartz grains occur firmly embedded by fibrous tissue in a dense cortex, one has to abandon all hopes of a thin slice, and to put up with a very bad example of a thick one.

For staining I have found hæmatoxylin most generally useful; picrocarmine and other carmine dyes have also been used, and with picrocarmine especially very elegant results may be obtained; this stain is particularly well adapted for use with the freezing process.

The stained specimens are brought into paraffin in the usual way, and cut by the Cambridge rocking microtome; with proper precautions, a liberal supply of freshly sharpened razors being regarded as one, rolling seldom occurs; more frequently one has to contend with a determined tendency of the ribbon of slices to fly back and attach itself to the brass cylinder which carries the object; this is due to an abundant disengagement of electricity, produced partly by the friction of the razor with the paraffin, and partly I imagine by the fracture of the innumerable siliceous spicules of the embedded sponge. The attraction between the ribbon and cylinder is most troublesome in dry weather. It may be overcome by strongly blowing away the ribbon with the breath from the razor while cutting. Rolling usually occurs when exceptionally thick slices are being cut; it may be obviated by holding a piece of writing paper close to the edge of the razor and parallel with it, leaving just enough room at the edge for the slice to pass under it. The paraffin which I have found most suited for this work is that supplied by the Cambridge Scientific Instrument Company, it melts at about 54° C., and is sufficiently hard for all purposes. If required softer, it can be mixed with paraffin of a lower melting point. In some few cases when I wished to obtain slices with the spicules of the Sponge as little displaced as possible (*e.g.*, in the case of *Tetilla merguiensis*, where it was necessary to ascertain the orientation of the calthrops-like triæna), I found the addition of a little Canada balsam dissolved in xylol useful; the xylol passes off in the water-oven, and the balsam remains to give additional toughness to the paraffin. In the few instances in which I tried this process, it certainly answered its purpose very well.

The slices when cut were attached to the glass slide by the absolute alcohol process; the slide is first washed with a camel's-hair brush dipped in absolute alcohol, and allowed to dry, the slices are then laid on it and the brush full of alcohol "dabbed" over them; slices, if at all wrinkled, spread out under this treatment and come to lie very evenly on the slide. The paraffin is then melted and washed away with xylol in the usual manner. In all cases the slices so prepared were finally mounted in balsam; other methods of attachment were employed, when paraffin-cut slices were brought into glycerine for final examination, but this was a process seldom employed; when glycerine preparations were required, the slices were usually cut by the freezing process, either embedded in gum or jelly. The gelatine freezing process has already been described by me, but it may be useful to add here a brief account of it, with some additional details, which experience has shown to be necessary. The fragment to be cut is brought into distilled water and thence into clear melted jelly, prepared from ordinary gelatine (Nelson's gelatine answers admirably); when the tissue has soaked till it is completely permeated by the jelly it is transferred to a Rutherford's freezing microtome, and when well frozen cut with a razor as cold as possible. It is at once transferred by a cold needle to a glass slide, an operation which requires skill, and which succeeds best in cold weather, since, owing to the excessive tenuity of the slice, the slightest elevation

of temperature causes it to thaw and wrinkle up. In hot weather the process is in consequence not practicable except in a freezing chamber. The slices are next covered with pure glycerine, and a cover-glass placed over them, glycerine jelly is run round the edge of this, and the slide is placed in the water-oven and left till the glycerine has completely converted the gelatine into glycerine jelly. If this part of the process is delayed for some few days, the gelatine undergoes some modification by which it is rendered incapable of pectinising with the glycerine, and this impairs the value of the preparation in two ways: in the first place the refractive index of the gelatine is higher than that of the glycerine, and this interferes with the optical clearness of the preparation; and in the next place the modified gelatine exerts in process of time a bleaching action on the stained tissue, and finally entirely discharges its colour. In ignorance of these facts many of my earlier preparations were left too long before warming, and are now in consequence almost worthless.

The value of glycerine in optically despiculising a sponge-slice has already been pointed out by me,[1] and subsequently by Schulze, but frozen slices mounted in glycerine have other advantages over paraffin preparations; for one thing the tissues suffer far less contraction, indeed in this respect there is no comparison possible between the two methods; but, still more important in the study of Sponges, comparatively thick slices can be cut with better results than in the case of paraffin preparations. The value of thick slices which have suffered only a minimum of contraction is well exemplified in the case of the sterrasters of the Geodiidæ; I should never have made out the scleroblast of these spicules in paraffin-cut slices, for with a full knowledge of what to look for I have only once or twice succeeded in finding them in such preparations; while in slices obtained by the freezing process there need never be any difficulty. Similarly the only traces of scleroblasts observed in connection with the adult desmas of the Lithistida were met with in slices obtained by freezing.

Isolation of the Spicules.—In the case of the Choristida a thin fragment cut from the surface almost to the centre of the Sponge is placed on a glass slide and boiled in excess of strong nitric acid; when all the soft parts have been thus destroyed, a triangular piece of blotting paper, moistened at one corner with water, is placed with the moistened corner touching the edge of the acid on the slide; when most of the acid has been drawn off, distilled water is added to the slide from a dropping tube and drawn off by blotting paper in the same way, when as much as possible has been removed from the slide lying flat, it is raised to slope at a gentle angle and the blotting paper replaced by a dry piece, the angle is gradually increased till the slide stands vertically. A second washing with water is necessary when the fragment of Sponge operated upon is of comparatively large size; when sufficiently washed with water, absolute alcohol is added and likewise drawn off by blotting paper. The slide is placed in the water-oven and when dry a little xylol

[1] Sollas, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. iv. p. 48, 1879.

is poured on, and if after examination under the microscope the spicules are found to be clear and dry, they may be at once mounted in balsam; if they have a dirty appearance they must be again washed with alcohol, but if the process has been carefully followed out this will seldom be found necessary. There are many advantages in this method, one of the chief being the fact that a complete sampling is obtained of the spicules of the Sponge, but few even of the most minute being lost. It is also speedy, but has the defect of not furnishing duplicates; if duplicates be desired it is best to boil the piece of Sponge in a watch-glass and to wash the residual spicules in water and absolute alcohol before transferring to glass slides; or the contents of the watch-glass may be emptied into a conical wine-glass filled with water, which may be left to siphon off through a wide capillary glass tube, the last traces being removed by a triangular piece of blotting paper supported vertically, absolute alcohol is added as before and the spicules transferred to glass slides by a dipping tube.

In the case of Lithistid Sponges, the spicules of which are grown together into a dense network, additional steps are necessary. A fragment of the Sponge is first boiled in nitric acid in a watch-glass, this liberates all the loose spicules, including the young forms of the desma, and an occasional almost adult example not yet completely incorporated with the skeleton. The skeleton itself remains as a coherent network, which may be removed with the forceps and washed in a beaker of distilled water. The nitric acid is removed from the loose spicules in the way already described in the case of the Choristida. The skeletal network is cut with a razor into fairly thin slices, which are thrown into water to separate useless chips, the slices are then removed, some are dried and mounted at once in balsam, others are subjected to further treatment in order to isolate the component desmas, with a view to studying their general form. This may be accomplished by boiling in caustic potash in a silver vessel, or by treatment with hydrofluoric acid. The later is the simplest plan, but both yield equally good results. In treating with hydrofluoric acid the thin slice of skeletal network is placed on a clean silver coin (a three-penny piece answers the purpose), it is covered with water and a drop of the acid added; after a few minutes, the exact time of course depends upon the size of the slice, the desmas fall apart with the slightest teasing, and immediately this happens the further action of the acid must be arrested; this is most simply accomplished by plunging the coin into a watch-glass filled with water, the water is then siphoned off with a wide capillary tube, and the last traces by blotting paper; a second washing with water follows, and after this is removed the spicules are washed out of the watch-glass by absolute alcohol; to accomplish this with thoroughness the glass should be held vertically and the alcohol delivered into it by means of a pipette; the edge of the watch-glass should touch the glass slide so that the alcohol as it flows out may form a continuous bridge between the slide and the watch-glass. This ensures complete transference of all the desmas to the slide.

By the last-described process we obtain entire and isolated desmas, somewhat corroded, but revealing the general form of the spicules with a completeness that leaves nothing to be desired; the slides obtained by the other processes afford us the one set, all the loose spicules and young desmas, the latter of the first importance; and the other the network with the desmas in their natural relations to each other.

DESCRIPTION OF GENERA AND SPECIES.

Tribe TETRACTINELLIDA, Marshall.

Demospongiæ with triæne or tetractine spicules or "Lithistid" desmas.

Order I. CHORISTIDA, Sollas.

Tetractinellida with triæne or tetractine spicules, but without "Lithistid" desmas.

Suborder I. SIGMATOPHORA.

Choristida in which the characteristic microscleres are sigmaspires.

Family I. Tetillidæ, Sollas.

Sigmatophora in which the characteristic megascleres are slender protriænes.

Tetilla, O. Schmidt.

The ectosome is never a cortex; the mesoderm is a collenchyma; and the chamber system eurypylous.

Tetilla sandalina, Sollas (Pl. I. figs. 16–27).

Tetilla sandalina, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 179, 1886.

Sponge (Pl. I. fig. 16) more or less fusiform or ellipsoidal; with a single oscule at one end, and papillose at the other; ectosome not developed. Mesoderm very small in quantity, collenchymatous; flagellated chambers large, round or elliptical, eurypylous.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. I. fig. 20), fusiform, anisoactinate, tapering

less gradually to a point at the distal than at the proximal end, which frequently becomes filiform; 2·326 mm. in length by 0·0237 mm. in diameter.

2. *Trichodal oxea*; immeasurably thin fusiform oxea, 0·395 mm. long, which, lying side by side with overlapping ends, give rise to spicular fibres (Pl. I. fig. 27).

3. *Protriæne* (Pl. I. figs. 21, 23–25). Rhabdome scarcely perceptibly less in diameter immediately below the cladome than near the actinal centre, thence tapering very gradually to a filiform termination. Cladi usually of unequal length, one, measuring 0·197 by 0·005 mm., longer than the other two, which are generally equal in size, viz., 0·0513 by 0·0039 mm.; the cladi are also sometimes reduced in number, one or even both of the shorter disappearing, the longer cladus alone remaining then measures 0·21 by 0·0054 mm.

II. Microsclere. 4. *Sigmaspire* (Pl. I. fig. 22). This is of the typical form, but is somewhat larger than usual, attaining a length of from 0·0237 to 0·0276 mm.

Anatriænes are absent.

Colour.—Dark ashen-grey.

Habitat.—Station 78, Azores, July 10, 1873; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Remarks.—Of this species, one of the simplest forms of *Tetilla*, two specimens were obtained; they are approximately of the same size, about 20 to 22 mm. long by 10 mm. wide. One bears a remarkable resemblance to a shoe or slipper, hence the name. The single oscule, 4·7 mm. wide, occupies a position corresponding to the opening of the shoe; its margin is produced into a short tube, supported by spicules, including numerous protriænes, which lie within its walls parallel to its length; internally it leads into a cloacal chamber, and into this the excurrent canals open freely by unconstricted apertures. In the other more fusiform specimen, the oscule is more nearly terminal in position, but otherwise similar. The opposite end of the sponge, corresponding to the toe of the shoe, is produced into numerous short papillæ, from which protriænes, but no anatriænes, project for a short distance outwards. These no doubt are reduced anchoring filaments. The sponge appears to have rested on one side, corresponding to the sole of the shoe, and if so the anchoring filaments would be without anchoring function, which might account for their reduction.

The spicules diverge spirally from an excentric node in short fibres which project obliquely beyond the surface of the sponge, rendering it hispid; the longer cladi of the protriænes usually have a common direction over limited areas.

The spicular fibres are of two kinds, those formed of large oxeas and protriænes, and those which consist solely of trichodal oxeas: at the oscular margins, the spicular fibres enter the wall of the oscular tube and assume a close palisade arrangement.

The exterior of the sponge (Pl. I. fig. 27) is covered by a dermis (ectoderm and

adjacent mesoderm), but is not differentiated to form a cortex; so too the walls of both systems of canals are without any special mesodermic investment. Vela are absent, as well as special subdermal cavities.

The flagellated chambers (Pl. I. figs. 17, 26), are usually ellipsoidal, and vary in size from 0·048 by 0·040 to 0·071 by 0·044 mm., measured along their longest and shortest diameters. They open by a wide mouth immediately into the excurrent canals. The canals of the sponge are largely occupied by the volcanic mud on which it rested, particles of pumice being particularly abundant.

The mesoderm, which is very poorly developed, contains large amœboid cells, but no genital products.

In general character *Tetilla sandalina* closely resembles *Tetilla polyura* as figured and described by Vosmaer,[1] but differs as much from *Tetilla polyura* as figured by Schmidt[2] as Vosmaer's representations do. But for the absence of anatriænes in the Challenger specimen, I should be disposed to regard them as merely varietal modifications of Vosmaer's species. That these spicules are not present I can assert confidently, for they are absent not only from the separate mountings of spicules, but also from thin sections of the entire sponge; nor are any to be seen when the whole sponge is examined under the microscope, although the ends of the projecting spicular fibres can thus be closely examined and their composition clearly determined.

Tetilla leptoderma, Sollas (Pl. I. figs. 1–15).

Tetilla leptoderma, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 179, 1886.

Sponge (Pl. I. fig. 1) more or less spherical or ellipsoidal, with a single oscule; produced below or at the end opposite the oscule into several slender rootlets; ectosome thin, consisting of modified collenchyma; mesoderm but sparingly present, collenchymatous; flagellated chambers large, pouch-shaped, eurypylous.

Spicules.—I. Megascleres. 1. *Oxea*, of the radial fibres, fusiform, anisoactinate (Pl. I. fig. 2), much more abruptly pointed at the distal than at the proximal end; 4·185 by 0·0474 mm. to 4·284 by 0·0434 mm.

2. *Oxeas*, irregularly scattered (Pl. I. fig. 5). These, though smaller than the preceding spicule, cannot be distinguished from young forms of it, measurements therefore are not given.

3. *Protriæne* (Pl. I. figs. 3, 9). Usually with one cladus longer than the other two, which are generally of approximately equal size. Rhabdome diminishing gradually from the cladome to an almost filamentous termination; rhabdome 4·03 by 0·0118 mm., the

[1] Sponges of the "Willem Barents" Expedition, p. 9, pl. i. figs. 1–3.
[2] Spong. Atlant. Gebiet., p. 66, pl. vi. fig. 8, 1870.

longer cladus 0·197 mm., the shorter 0·1065 mm. long. In another specimen this spicule is 6·426 mm. long.

4. *Trichodal protriænes* (Pl. I. figs. 10, 11, 12). Similar in general form to the preceding, but much smaller and remarkably tenuous, so as to appear hair-like. The unpaired cladus much longer than the paired cladi. Rhabdome 1·162 mm. long; unpaired cladus 0·06 mm., paired cladi 0·012 mm. long.

5. *Somal anatriæne* (Pl. I. figs. 4, 7). Rhabdome fusiform, expanding at the cladal origin, cladi long and slender, cladome rounded off in a wide curve in front, axial fibre of the rhabdome not produced beyond the origin of the cladi. Rhabdome 0·01 mm. in diameter in the middle, tapering to a filamentous proximal end, distally at first attenuating to a diameter of 0·004 mm., then growing thicker till it attains a diameter of 0·0158 mm. immediately below the cladome; length about 6·0 mm.; cladi 0·118 by 0·012 mm. In another specimen the dimensions of the spicule are as follows:—Rhabdome 7·4 by 0·0197 mm. below the cladome, diminishing to 0·004, increasing to 0·0078 mm., and then attenuating to the proximal extremity; cladi 0·079 by 0·0118 mm., chord 0·142 mm.

6. *Radical anatriæne* (Pl. I. fig. 6). This is distinguished from the somal anatriæne by the characters of the cladome, which is more massive, and terminates distally in a rounded mucrone; the axial fibre of the rhabdome is continued forwards past the origin of the cladi to the end of the mucrone. Rhabdome from about 6·05 by 0·0355 mm. to 6·79 by 0·0276 mm., cladi 0·154 by 0·0237 mm., distal extension of axial fibre 0·0276 mm. In another specimen this spicule has the following dimensions:—Rhabdome 7·5 by 0·0276 mm. below the cladome, diminishing to 0·0118, and then increasing to 0·0158 mm.; cladi 0·122 by 0·0197 mm., chord 0·118 mm., axis of rhabdome continued past the origin of the cladi for 0·0197 mm.

II. Microsclere. 7. *Sigmaspire* (Pl. I. fig. 8). Of the usual form, from 0·0138 to 0·0197 mm. long.

Colour.—Ashen-grey.

Habitat.—Station 320, off the Rio de la Plata, South America, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2.

Remarks.—Six specimens of this sponge were trawled. All are more or less spherical, except one which is a prolate ellipsoid. The specimen figured measures 15 mm. in height, or 30 mm. if the anchoring filaments be included, and 17 mm. in breadth; the smallest specimen is 5 mm. high by 4 mm. broad.

The single oval oscule is excentrically placed on the obliquely depressed upper surface of the specimen figured. It measures 3·18 by 1·6 mm. Its margins are produced into a short membranous tube, strengthened by a dense layer of longitudinally

arranged trichodal protriænes, the cladomes of which project beyond the aperture, as though for defence. The surface of the sponge is irregularly reticulate with numerous low anastomosing ridges, surrounding oval depressions, in which the pores are situated. These are round or oval openings, about 0·044 mm. in diameter; they lead directly into wide incurrent canals, which are crossed by numerous vela (Pl. I. figs. 12, 14). The excurrent canal divides into branches, which are comparatively of large diameter up to their ultimate ramifications, and are not provided with vela.

Fragments of pumice and other foreign bodies are abundant in the incurrent canals, and food residues occupy the ultimate branches of the excurrent canals.

Ectosome (Pl. I. fig. 15).—The ectosome varies considerably in thickness, from about 0·06 to 0·118 mm.; it consists of somewhat modified collenchyma, many of the collencytes being elongated into fusiform fibre-cells, which run chiefly more or less parallel with the surface; others in some parts acquire a vesicular character, and together with the fusiform fibres produce a fibrous vesicular tissue. Some of the collencytes appear to have lost nearly all the protoplasm of the cell-body, and to have become reduced to mere nuclei with their nucleoli; others are of the ordinary stellate branching form, and some of these where they lie near the ectoderm of the outer surface send a slender process to it, and give off on the opposite side two other similar processes, which descend into the interior; whether these become connected with other cells or not is an open question. It will be seen from this description that the ectosome of *Tetilla leptoderma* is more highly developed than that of *Tetilla sandalina*; in succeeding species of the genus we shall find this development carried further, foreshadowing the corticate type.

Choanosome (Pl. I. fig. 13).—The mesoderm is remarkably poorly developed; it consists of collenchyma, in which, besides collencytes, numerous deeply stained more or less oval cells occur, which appear to be contracted amœboid cells. In some cases the flagellated chambers appear to be flattened against one another or against the epithelium of the canals, with scarcely a discernible trace of mesoderm between them.

The flagellated chambers are more or less spherical or ellipsoidal pouches, sometimes approaching the form of cylindrical sacs—on an average they measure 0·06 by 0·05 mm. but are sometimes larger, in one case an oval section gave 0·081 and 0·067 mm. for the two diameters. They communicate abruptly by a wide mouth, 0·032 mm. in diameter, with the excurrent canal; and by a single large prosopyle with the incurrent canal.

The spicular fibres of the body consist of the fusiform oxeas (1), protriænes (3), and somal anatriænes (5), and near the surface chiefly of the latter, which form a diverging sheaf extending beneath the ectosome and through it to the exterior (Pl. I. fig. 15). The smaller oxeas (2) are not aggregated into fibre, but are loosely scattered throughout the sponge, with a kind of "criss-cross" arrangement, between the radiating fibres. At the surface their points project slightly, raising the ectoderm into

tent-like eminences. Towards the base of the sponge the somal anatriænes pass into the radical form (6), and the protriænes become more numerous. The differentiation in form is evidently connected with a difference in function either in kind or more probably in degree. The rooting anatriænes can only resist a pull, they have no rigidity capable of meeting a thrust, and hence we may regard them as strictly comparable in their action to the anchors used for securing ships at sea.

The trichodal protriænes are most abundantly developed around the edges of the pore-areas (Pl. I. fig. 12), and about the margin of the oscule. The number of the cladi is frequently reduced to two, or one, or they may be altogether absent, the distal club-like thickening from which they arise when present still, however, persisting.

Owing to the tenderness of the ectosome, and the loose way in which the spicules of the fibres are aggregated, the sponge is extremely soft and easily torn. The course of the fibres is but slightly spiral.

Tetilla pedifera,[1] Sollas (Pl. XLI. figs. 6–21).

Tetilla pedifera, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 180, 1886.

Sponge somewhat thumb-shaped, erect, sessile (?). Surface finely hispid, owing to the projection of brushes of protriænes; raised into irregular, somewhat tent-like eminences, which tend to form ridges; oscules numerous, small, 1 mm. in diameter and less, usually situated on the summit of the tent-like projections; oscular margin a wide smooth membrane, roofing over an excurrent canal of greater diameter than the oscule. Pores apparently distributed irregularly over the surface. Ectosome thin, supported by numerous oxeas, which lie in all directions, parallel to its surface.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, anisoactinate, maximum thickness nearer the distal than the proximal end, the latter frequently attenuated to a filiform extremity, always more sharply pointed than the distal end, 3·213 by 0·03 mm.

2. *Protriæne* (Pl. XLI. figs. 9–11). A slender conical rhabdome attenuated to a sharply pointed filiform extremity; usually slightly swollen just below the origin of the cladi; cladi simple, three, two, or only one in number, slightly curved, directed forwards, and only very slightly outwards, usually of unequal length; when all three are present two are of about equal length, but much shorter than the third; this form by the loss of one of the shorter cladi produces the variety with two, and by the loss of both the shorter cladi the variety with one cladus; rhabdome 2·38 by 0·0118 mm.; the cladi vary slightly in length according to the number present; in the true triæne form, the longer cladus is about 0·15 mm., the shorter cladi about 0·06 mm. long; in the diæne, the longer is 0·152, the shorter 0·071 mm. long; when only one cladus is present it measures 0·158 mm. in length.

[1] *Pedum*, a shepherd's crook.

3. *Anamonæne* (Pl. XLI. fig. 12). This is a very characteristic form, somewhat resembling a shepherd's crook. The rhabdome is conical, wide at the cladome, tapering rapidly to a filiform extremity; there is never more than one cladus present; this is as wide as the rhabdome for nearly half its length, directed at first forwards and only very slightly outwards, then rapidly recurving backwards and very slightly outwards; rhabdome 4·46 by 0·0276 mm., cladus 0·13 mm. long, measured along two chords, one from its origin to the middle of its curvature, the other thence to the point; chord 0·055 mm.

II. Microscleres are absent.

Colour.—Greyish-white.

Habitat.—Station 196, between Amboina and Samboangan, October 13, 1874; lat. 0° 48′ 30″ S., long. 126° 58′ 30″ E.; depth, 825 fathoms; bottom, hard ground; bottom temperature, 36°·9.

Remarks.—The single specimen obtained of this sponge measures 17 mm. in diameter, and 24 mm. in height. It is readily distinguished from all other species of *Tetilla*, except *Tetilla coronida*, by the presence of the anamonæne, and it is the only species of the genus in which microscleres are not present.

The ectosome is a very thin collenchymatous layer, usually not more than 0·02 mm. thick; below the investing epithelium it presents a few fusiform cells tangentially disposed; about the margins of the oscules these are more abundantly developed and concentrically disposed to form a sphincter. The concentric fibres are crossed by others running radiately, the outer ends of these project a little beyond the surface, their inner ends are either simple or once branched, and appear to unite with large branching collencytes which lie on the distal border of the sphincter. These radiating fusiform cells stain deeply with hæmatoxylin; they are about 0·04 mm. long, with an oval nucleolus about 0·004 mm. long, and a deeply stained spherical nucleolus.

The choanosome (Pl. XLI. fig. 7) may be regarded as composed of a folded lamella, consisting of an ectodermal epithelium on one face, separated from an endodermal epithelium on the other by a single layer of closely adjacent flagellated chambers, with a very small quantity of intervening collenchymatous mesoderm. By the folding of this lamella and the coalescence of the folds in places, a complicated labyrinthic structure arises, the spaces in which, bounded by the endoderm, are the excurrent canals, and those bounded by the ectoderm the incurrent canals. These canals are therefore reduced to their simplest expression; they are not provided with vela or special walls. The flagellated chambers are about 0·04 mm. long by 0·032 mm. broad; the thickness of the folded sponge-wall is thus also about 0·04 mm.

Genital Products (Pl. XLI. figs. 7–20).—The mesoderm contains not only flagellated chambers, but clusters of spermatozoa in various stages of development. These resemble

the flagellated chambers in shape and size, and frequently occupy the place that would otherwise be taken by these chambers, but sometimes they project beyond the general surface of the sponge-lamella into the sinus of a canal.

In their earliest observed stage they exist as single, finely granular, deeply stained oval cells situated in the mesoderm, and about 0·0197 by 0·0158 mm. in size (Pl. XLI. fig. 13). This primitive oval cell by repeated segmentation gives rise to cells continually increasing in number and diminishing in size, till the mature spermatozoa are produced. The sperm-clusters lie within definite cavities of the mesoderm, lined by so-called endothelium; they are not provided with a "cover cell." The cavities are mostly larger than the clusters, owing to shrinkage consequent on preservation in spirits. The largest cluster of mature spermatozoa observed measured 0·045 mm. in diameter, the containing vesicle 0·064 mm.

Some of the commoner stages represented furnish the following characters. In a cluster 0·032 mm. in diameter, the cells are spherical granular bodies 0·0079 mm. in diameter, with a clear vesicular nucleus and small deeply stained spherical nucleolus. In more advanced clusters 0·04 mm. in diameter, the cells have diminished to 0·004 mm. in diameter, the general protoplasm is much diminished in quantity, the nucleus with its darkly stained nucleolus constituting the greater part of the cell. In still more advanced stages scarcely anything but nucleus and nucleolus remain, the little spherical cells now measure 0·002 mm. in diameter. Finally we meet with the mature spermatozoa, the heads of a round or oval outline, 0·001 mm. in diameter, furnished with tails, the length of which it was not found possible to measure (Pl. XLI. fig. 20). The head has every appearance of being the transformed nucleolus.

Problematical Body (Pl. XLI. fig. 21).—Occupying a position similar to that in which the sperm clusters occur, and deceptively similar to them in structure, is a curious little body of which a series of sections were obtained, one of which is shown in the figure. It is a spherical cluster of cells, each of which measures about 0·008 to 0·01 mm. in diameter; their outline is circular or oval, and they consist of very faintly stained protoplasm, embedding a large oval deeply stained nucleus, 0·003 mm. in diameter, and one or more small, deeply stained granules, which are surrounded by a clear spherical space. That this is not a cluster of developing sperm-cells, is shown by the presence of a structureless, colourless, transparent membrane, within which the cell-aggregate is enclosed. By this feature also the possibility of its being a segmenting ovum of the sponge is excluded; and it would appear to be a stage in the segmentation of the ovum of some other organism foreign to the sponge.

Tetilla coronida,[1] n. sp. (Pl. XXXVIII. figs. 13–17).

Sponge (Pl. XXXVIII. figs. 13, 14) spherical, depressed (button-shaped), with a somewhat sharply marked equatorial margin; surface slightly hispid, raised into low conules, incrusted with grains of sand, Foraminifera, and other foreign bodies, base produced into rooting fibres. A single oscule situated in the centre of the upper surface, its margins produced into a short membranous transparent tube.

Spicules.—I. Megascleres. 1. *Oxea*, isoactinate, fusiform, very sharply pointed, 3·37 by 0·037 mm.

2. *Protriæne* (Pl. XXXVIII. fig. 15), rhabdome regularly tapering from the cladome to a filiform extremity, 3·37 by 0·02 mm.; cladi usually strongylate 0·1 mm. long, chord 0·071 mm.

3. *Anatriæne* (Pl. XXXVIII. fig. 16), rhabdome fusiform, 7·14 mm. long, at the actinal origin about 0·015 mm. in diameter, tapering thence in both directions, esactine ending in a filiform extremity, ecactine enlarging below the cladal centre to twice its previous diameter at its origin; cladi 0·1 mm. long, chord 0·11 mm.

4. *Anamonæne* (Pl. XXXVIII. fig. 17), this is a reduced and modified protriæne, two of the cladi being suppressed, and the remaining one recurved at about the middle of its length; the single cladus is 0·28 mm. long, measured along two chords, one from its origin to the middle of its curvature, the other thence to its termination.

II. Microsclere. 5. *Sigmaspire* of the usual form, 0·016 by 0·002 mm.

Colour.—Dark grey, speckled with black and white by incrusting foreign matter.

Habitat.—Station 150, off Heard Island, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; depth, 150 fathoms; bottom, coarse gravel; bottom temperature, 35°·2.

Remarks.—This little sponge, represented about twice its natural size in the illustration (Pl. XXXVIII. figs. 13, 14), measures 13 mm. in length by 10 mm. in width and 8 in height.. It resembles *Tetilla pedifera* in so far as it is characterised by the remarkable shepherd's crook spicule or reduced protriæne, which, however, is far less abundant in this sponge than in *Tetilla pedifera*.

The two species are otherwise very sharply distinguished; they not only differ in habit, external form, and in the characters of the oscules, but in *Tetilla coronida* somewhat large sigmaspires are abundantly present, while microscleres do not occur at all in *Tetilla pedifera*. The single cladus of the anamonæne in the latter sponge is only one-half the length of that in the former.

Although the anamonæne looks at first sight like a reduced anatriæne, it is much more probably a modified protriæne; the single cladus for the first half of its course projects forwards, and the suppressed cladi, as represented by short axial fibres which

[1] κορωνίς, ίδος, crook-beaked.

terminate within the spicule without affecting its form, are wholly and highly orrectate, reminding one of the two shorter cladi which occur in protriænes characterised by one cladus much longer than the other two.

Tetilla grandis, Sollas (Pl. V. figs. 1–14).

Tetilla grandis, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. i. p. 180, 1886.

Sponge (Pl. V. figs. 1–3) large, somewhat cylindrical or ellipsoidal in form, anchoring filaments matted together to form a massive base. Oscules several, comparatively small, the patent openings of the excurrent canals, chiefly distributed on the summit of the sponge. Surface more or less hispid, raised into ridges and low papillæ, which unite to form an irregular reticulation, in the depressions of which the pores are situated in groups. Ectosome thicker than in most *Tetillæ*, consisting of fibrous and fibro-vesicular collenchyma. The skeleton consists of spicular fibres radiating spirally from an excentrically situated core.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, anisoactinate, the distal end more obtusely pointed than the proximal, which is sometimes almost filiform. The difference between the two ends is less marked in spicules occurring near the origin of the fibre, than in those which form its peripheral ends, where they may sometimes be seen with the distal end quite rounded off, or strongylate; from 6·07 by 0·075 to 5·72 by 0·079 mm.

2. *Protriæne*, rhabdome cylindro-conical, diminishing from the cladome to a filiform termination; cladi typically three in number, but frequently reduced to two or even one. Rhabdome 8·6 by 0.0158, cladi 0·15 by 0·0118 mm.

3. *Trichodal protriæne*, usually with one cladus longer than the other two, which are equal in length; chiefly disposed about the cribriform areas over the incurrent canals.

4. *Sonal anatriæne* (Pl. VI. fig. 6) a fusiform rhabdome, attenuated proximally to a filiform extremity, distally at first diminishing and then increasing in diameter up to the cladome; cladome rounded in front, axial fibre not prolonged into it, cladi long, slender, springing from the rhabdome in a bold sweeping curve. Rhabdome 12·14 by 0·02 mm. just below the cladome, diminishing to 0·006, and then increasing to 0·0118 mm. in diameter, finally tapering to its filiform extremity; cladi 0·158 by 0·0118, chord 0·16 mm.

5. *Radical anatriæne.* The cladal end of the rhabdome is much thicker than that of the cortex, and provided with shorter stouter cladi; the axial fibre of the rhabdome extends halfway into it. The rhabdome is thickest just below the cladi, and somewhat rapidly tapers for the first half of its course, and then more gradually till it ends in a filiform termination. Rhabdome 31·5 by 0·0315 near the origin of the cladi, 0·0276 just beyond their points, and 0·021 mm. a little more than a millimeter lower down;

cladi 0·1 by 0·0237, chord 0·1 mm.; cladal end of rhabdome 0·021 mm. long, the axial fibre of the rhabdome extending into it 0·079 mm.

II. Microsclere. 6. *Sigmaspire* of the usual form; 0·0118 mm. long.

In young specimens the spicules are smaller, in correspondence with their size; thus, in an individual measuring 18 and 13 mm. along two diameters, the oxea is only 3·5 mm. long; in another, 32 and 26 mm. in diameter, it is 4·65 mm. long.

Colour.—White to yellowish-grey.

Habitat.—Kerguelen, 10 to 100 fathoms.

Station 149B, off Royal Sound, Kerguelen, January 17, 1874; lat. 49° 28′ S., long. 70° 30′ E.; depth, 25 fathoms; bottom, volcanic mud.

Remarks.—About fifty specimens of this fine sponge were brought from Kerguelen, where they grow in company with *Cinachyra barbata*. The largest is 130 mm. high, and 75 mm. in diameter, but is without roots. One specimen, 92 mm. high and 70 mm. in diameter, stands on a basal mass 32 mm. high and of about the same diameter as the sponge.

In its youngest state, as represented by a specimen 8 mm. in diameter, the sponge is nearly spherical (Pl. V. fig. 4); it soon becomes egg-shaped, and the narrow end is produced into anchoring tufts, which as it increases in size very soon agglomerate into wool-like clots; and by the time the sponge has reached a height of 25 mm. it is provided with the characteristic basal mass.

The ectosome is about 0·3 to 0·8 mm. thick; it consists of fibro-vesicular collenchyma, the vesicles being more numerous in the outer, and the fibres in the inner part of the layer. Just below the epidermis the vesicles are comparatively small and filled with faintly stained protoplasm, enclosing an oval nucleus with its nucleolus. Deeper towards the interior the vesicles are much larger, 0·0276 by 0·0395 mm., and the included nucleus, surrounded by a thin film of protoplasm, lies at some distance from the walls, with which it is connected by thin protoplasmic strands. In the larger cavities the remains of several cells usually occur (Pl. V. fig. 5), but they disappear subsequently, so that in the largest cavities no trace of cells may occur.

The ectosome is not sharply marked off from the choanosome; the appearance of flagellated chambers in the latter is the only certain sign by which it can be distinguished.

The flagellated chambers differ considerably in size amongst themselves, the larger ranging from 0·032 to 0·044 mm. in diameter. They are eurypylous, the prosopyle measures about 0·0125 mm. in diameter, the apopyle from 0·02 to 0·03 mm. in diameter. Around the margin of the apopyle two or three sigmaspires are frequently embedded; and a nucleus with granular protoplasm sometimes lies on one side, the protoplasm apparently extending around the margin, the whole suggestively like a single bounding myocyte.

The choanocytes are well preserved; all the details of their well-known structure, except the collar, being clearly displayed. The fenestrated membrane is preserved in some of the chambers only, and when present the flagella are not visible. On the other hand, when the flagella are preserved the fenestrated membrane cannot be traced. The length of the body of a collencyte is about 0·004 mm., of the flagellum 0·016 mm.

The mesoderm of the choanosome is a collenchyma; it varies considerably in relative abundance, amongst the chambers it is frequently very poorly developed, the walls of these often lying nearly in contact with each other, but in other places it attains considerable thickness, and is subject to extensive modification; thus it forms a proper wall to the water canals, which are furnished with vela, usually provided with sphinctrate apertures, and it follows the spicular fibres in their course, and then contains numerous fusiform cells which usually lie parallel to the length of the spicules.

Genital products.—Sperm masses are abundantly present, occupying cavities in the mesoderm. They arise from finely granular cells, about 0·018 mm. in diameter, with an evident oval nucleus 0·007 mm. in diameter, and a spherical nucleolus 0·003 mm. in diameter; similar but smaller cells occur in the mesoderm, down to 0·008 mm. in diameter. By segmentation of the mother cell the sperm mass is produced. It is not enclosed in a cover-cell, but the cavity of the mesoderm in which it lies is lined by so-called endothelium, surrounding which is the usual collenchyma, without any special accumulation of collencytes. The developing sperm clusters occur in cavities of from 0·04 to 0·05 mm. in diameter, but the mature sperm occupies cavities of much larger size, from 0·1 to 0·175 mm. in diameter. The ripe spermatozoa present an oval head, about 0·001 mm. long, from the side of which, near one end, the "tail" arises and attains a length of about 0·01 mm. or more.

Skeleton.—The spicular fibres are spirally arranged, in a manner which will be found more precisely described under the species *Cinachyra barbata*, where a similar arrangement obtains.

Spicules.—The triænes begin to appear within the choanosome, just below the ectosome; the youngest forms are found at a distance of about 2·25 mm. below the outer surface, and between these and the exterior a series of cladomes of gradually increasing size occur.

The cladomes of the triænes lie on the exterior of the spicular fibre, and it would appear to be owing to the pressure exerted against them, when they come in contact with other spicules, that one or more cladi are sometimes suppressed, or, if not suppressed, forced into an irregular mode of growth, by which they become deformed, one or more cladi of an anatriæne, for instance, pointing forwards instead of backwards, or, if retaining their usual direction, losing the usual regular curve and becoming crooked.

Associated with these variously deformed spicules are others in which a fourth cladus is developed, but this more frequently happens with the anatriænes than the protriænes.

Sometimes, again, and this is a fact of some importance, a cladus of either a protriæne or anatriæne gives off a secondary cladus at the point of enforced bending, and thus becomes dichocladose. I have previously suggested that bending leads to the budding of fresh cladi at the point of flexion, and this seems to be a case in point; for dichotriænes are unknown amongst the Tetillidæ as regular constituents of the skeleton, and we have not the least fragment of evidence to show that they have descended from ancestral sponges which once possessed them, but many general considerations to the contrary. Hence, when bifurcation arises, as in this case, we must regard it as a variation appearing *de novo*, and may attempt to account for it by the conditions of the case, which appear in this instance to be the action of secondary pressures or tensions different to those under which the regular triæne form was produced.

The oxea also exhibits interesting departures from the normal type. The distal end is not unfrequently rounded off, and this may occur close to where the point would otherwise have been, or a millimeter or more away from it. Not only so, but secondary cladi may be developed from it, thus producing in a rudimentary and unsymmetrical form a kind of prodiæne spicule (Pl. V. fig. 13).

The young anatriænes (Pl. V. fig. 7) differ from the adult in that they terminate distally in a swollen bulb-like end, through which the axial rod or fibre passes, and after enlarging somewhat in the middle of the cladome, continues right up to the end of the spicule. From the sides of the bulb the cladi project, making a larger angle with the rhabdome than they do in the adult spicule. In the adult spicule the axial fibre is not continued past the origin of the axial fibre of the cladi. In the young forms one sometimes meets with a projection of the rhabdome for some considerable distance beyond the cladome; it then terminates in a rounded end (Pl. V. figs. 8, 9). This seems to me a point of some significance in connection with the question of the origin of the triæne.

The differentiation of the anatriænes into those of the cortex and those of the roots, seems to stand in connection with the additional tension to which those of the roots are exposed.

The young protriænes (Pl. V. figs. 10, 11) differ from the adult in somewhat the same fashion as in the case of the anatriænes.

Tetilla grandis, var. *alba*, nov. (Pl. V. fig. 3).

Sponge similar to *Tetilla grandis*, but distinguished by the absence of an anchoring basal mass. In addition, the flagellated chambers are larger, attaining a diameter of from 0·0513 to 0·0671 mm.

The spicules, which are quite similar to those of *Tetilla grandis*, gave the following measurements:—*Oxea* 5·7 by 0·063 mm.; *protriæne* 11·78 by 0·0316 mm.; *trichodal protriæne* 1·0 mm. long; *anatriæne* 19·6 mm. long, 0·0118 mm. broad in the middle

diminishing distally to 0·005 mm., and then increasing to 0·02 mm. just below the cladome; cladi 0·18 long, chord 0·175 mm.

Habitat.—Christmas Island, 120 fathoms, January 29, 1874.

Station 150, Heard Island, February 2, 1874; lat. 52° 4′ S., long. 71° 21′ E.; depth. 150 fathoms; bottom, coarse gravel; bottom temperature, 35°·2.

Remarks.—The general appearance of this variety differs in an undefinable way from *Tetilla grandis*, chiefly owing to the projection of long spicules all over the sponge, and these lying flat on the surface give it a white glistening appearance. The absence of an anchoring mass is probably connected with a difference of the ground on which the sponge occurs; *Tetilla grandis* lives on a muddy bottom, and *Tetilla grandis*, var. *alba*, on coarse gravel.

Tetilla merguiensis (Carter).

Tethya merguiensis, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xi. p. 366, pl. xv. figs. 6–8, 1883.

Sponge, a thick disc with rounded edges, or cushion-shaped, texture loose; surface densely hispid; ectosome thin, densely charged with pigment-cells; oscules several, large; pores in sieves.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, anisoactinate, 3·2 by 0·04 mm. (Ch.),[1] 4·2 by 0·058 mm. (Cr.).

2. *Protriæne*, rhabdome fusiform, cladome variable, tending towards two types, one in which the cladi are comparatively short and thick, the other in which they are longer and more slender. Rhabdome 3·5 by 0·008 mm. (Ch.), 6·17 by 0·013 mm. (Cr); cladome, cladi 0·0775 mm., sagitta 0·071 mm., chord 0·0645 mm. in length (variety 1 Ch.); cladi 0·2 mm. long (variety 2 Ch.); cladi 0·09 mm., chord 0·05 mm. long (Cr.).

3. *Anatriæne*, rhabdome conical, attenuating from the cladome to a hair-like termination, cladome terminal, cladi not very much recurved. Rhabdome 3·5 by 0·009 mm. (Ch.), 6·17 by 0·007 mm. (Cr.); cladome, cladi 0·0387 mm., chord 0·058 mm., sagitta 0·026 mm. in length (Ch.); cladus 0·039 mm., chord 0·058 (Cr.).

4. *Ectosomal orthotriæne*, rhabdome conical, usually shorter than the cladi, frequently strongylate; in one instance the rhabdome measured 0·058 mm., the cladi 0·206 mm. in length; in another the rhabdome 0·10 mm., and the cladi 0·21 mm.; in a third the rhabdome 0·13 mm., and the cladi 0·10 mm.; the maximum length attained by the cladi in the Challenger specimens is 0·27 mm., in Carter's specimen 0·43 mm.

II. Microscleres. 5. *Microxea;* 0·25 mm. in length, immeasurably thin. 6. *Sigma-spire;* 0·017 mm. (Ch.), 0·016 mm. (Cr.) in length.

Colour.—Brownish-black.

[1] (Ch.) indicates measurements obtained from Challenger specimens, (Cr.) from Carter's specimen.

Habitat.—Cape York, Torres Strait; depth, 3 to 11 fathoms.
Distribution.—King's Island, Mergui Archipelago; coast of Burmah.

Remarks.—The single specimen of this sponge in the Challenger collection is a conical segment of a more or less rounded sponge, with an apex corresponding to the centre of the sponge, the sides to the radiating spicular fibres, and the base, which is more or less flattened, to the outer surface of the sponge; it measures 12 mm. in radius and 12 mm. in width across the base. It would appear therefore to have been torn away from a specimen which was somewhat larger than that described by Carter. Carter's specimen, however, is complete, and this may account for the greater length of the triænes given in his measurement, though it will not explain the larger size of the oxeas. The general characters of the spicules in the two specimens are, however, so similar that, notwithstanding this, I have not felt justified in creating a separate species for the Challenger specimen.

The ectosome varies from 0·16 to 0·27 mm. in thickness, and consists of collenchyma, the matrix of which stains with hæmatoxylin, and the collencytes of which are not usually visible; small fusiform cells occur in it, especially where it adjoins the choanosome, and pigment-cells are closely scattered through it, they are round or oval in outline, about 0·08 mm. in diameter, and contain numerous darkly coloured pigment-granules enclosed within a distinct cell-wall. Most of the megascleres of the sponge are arranged in radiating fibres, but a few lie loosely scattered tangentially in the ectosome. I have not been able to satisfactorily determine the characters of the choanosome. They appear to be somewhat abnormal. The flagellated chambers appear to be somewhat small, about 0·0276 mm. in length. I could not discover the manner of their communication with the excurrent canals, but they do not present a eurypylous appearance. The mesoderm appears to be generally granular, but a number of vesicles, about 0·0118 mm. in diameter, are scattered through it; they contain an oval, protoplasmic, deeply-stained, nucleated body; with these occur less frequently pigment-cells; in places this tissue passes into one wholly composed of the vesicular cells, separated by a framework composed of small fusiform cells, which run in one general direction, curving on each side of the vesicular cells; not more than one fusiform cell lies between two vesicular cells as a rule.

The megascleres, as previously stated, are chiefly arranged in spicular fibres, but the ectosomal orthotriænes are separately distributed throughout the ectosome, within which they are entirely immersed. From Carter's illustrations they have much the appearance of calthropides, though Carter himself terms them zone-spicules. This suggests several interesting questions, for the solution of which slices showing these spicules in their true orientation are necessary. These I readily obtained by adding Canada balsam to the paraffin used for embedding, which thus acquired great toughness, and by cutting the

slices fairly thick. I then found that the cladi diverge from the rhabdome at about a right angle, and that the spicule is usually orientated, with the rhabdome radial and the cladi tangential in position with respect to the sponge; so that the spicule appears to be an orthotriæne with a remarkably short rhabdome, situated more deeply within the ectosome than is usually the case with this spicule. Fortunately I observed in several instances, lying close by the side of the fully formed spicule, smaller examples representing it at a very early stage. These are always plagiotriænes in which the relative length of the cladi and rhabdome is normal, *i.e.*, the rhabdome is considerably longer than the cladi, *e.g.*, in one instance, the rhabdome measured 0·065 mm., and the cladi 0·026 mm. in length. These pass into the adult by a general growth, involving both rhabdome and cladi, but the latter increase at a far greater rate than the former; so that in the fully formed spicule they attain a considerably greater length. The young spicules probably arise from a scleroblast budded off by that of the adult, with which they are associated, towards the completion of its growth.

The supposed calthrops which makes such a startling appearance in *Tetilla* is thus nothing more than an interesting modification of an ordinary triæne; and not a persistent tetraxon. In other sponges, such as *Pacillastra* (*Normania*), in which an apparent calthrops occurs in the choanosome, it is equally possible that it is not derived from a microcalthrops, but from a triæne; and furthermore, as the calthrops of the Pachastrellidæ is almost certainly descended from that of *Pacillastra*, a triæne origin may likewise possibly be ascribed to it.

In some cases it appeared to me that when oxeas occurred lying tangentially in the ectosome, the young triænes were displaced from their normal position, the rhabdome having a tangential position; if so we have a still further approach to the conditions under which the calthrops occurs in *Pacillastra*, and further, the apparent short rhabdome of the adult orthotriænes in the *Tetilla* may in some cases be really a cladus turned out of the tangential into the radial position by a rotation of the whole spicule. These cases may, however, possibly be explicable as artificially produced in the process of cutting.

The microscleres, both microxeas and sigmaspires, are scattered generally throughout the sponge.

Tetilla sp.

Sponge small, ovate, free, surface pilose, spicules projecting obliquely from the surface, and chiefly towards the base; ectosome a fibro-vesicular collenchyma about 0·02 to 0·047 mm. thick. Choanosome with a richly-developed collenchymatous mesoderm, which forms a somewhat thick layer about the walls of the chief canals, and is

abundantly present in the neighbourhood of the flagellated chambers, where it is finely granular. Flagellated chambers 0·04 mm. in diameter.

Spicules.—I. Megascleres. 1. *Oxea*, anisoactinate, fusiform, more finely pointed at the proximal than at the distal end; 2·5 by 0·031 mm.

2. *Protriæne*, a conical rhabdome, tapering to a filiform termination; cladi two nearly equal in length, but shorter than the third; rhabdome 2·32 by 0·01 mm.; cladi—longer 0·14 mm., shorter 0·067 mm. in length.

3. *Trichodal protriæne* of the usual form, very diminutive.

4. *Anatriæne*, a conical rhabdome, tapering from the cladome to a filiform termination; 2·856 by 0·0135 mm.; cladi 0·075 mm. long, chord 0·075 mm., the axial fibre of the rhabdome extends 0·008 distally beyond the origin of the axial fibres of the cladi, the cladal end of the rhabdome correspondingly projects in a rounded process in front.

II. Microsclere. 5. *Sigmaspire* of the usual form, 0·012 mm. long.

Colour.—White, of a faintly grey tint.

Habitat.—Station 236, off Japan, June 5, 1875; lat. 34° 58′ N., long. 139° 29′ E.; depth, 775 fathoms; bottom, green mud; bottom temperature, 37°·6 F.

Remarks.—There is but a single small specimen of this sponge; it measures about 7 mm. in height and 6 mm. in breadth; it is probably a very young form, and, as it does not offer any unusual or particularly distinctive character, I refrain from giving it a name.

The characters of the oscules and pores I could not determine.

Chrotella,[1] n. gen.

The ectosome is a cortex, excavated by subdermal cavities, and furnished with tangentially disposed spicules.

Chrotella simplex, Sollas (Pl. II. figs. 1–4).

Chrotella simplex, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 181, 1886.

Sponge ellipsoidal or subspherical, free, surface uniformly pilose, conules absent. Oscules small, one or more in number. Pores in sieve-like areas overlying the subdermal cavities.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, almost isoactinate; 2·8 to 3·0 mm. by 0·0217 to 0·0237 mm.

2. *Protriæne* (Pl. II. fig. 3). Rhabdome cylindrical, tapering to a filiform termination; cladi conical, widely extended; rhabdome 3·4 by 0·02 mm.; cladi 0·158 by 0·016 mm.

[1] χρώς, ὁ, χρωτός, the skin.

3. *Anatriæne* (Pl. II. fig. 4). Rhabdome cylindrical, tapering to a filiform end, cladi conical recurved, axial fibre continued past the cladal origin into the cladome, which is sometimes rounded, sometimes pointed in front; rhabdome 5·3 by 0·0158 mm.; cladi 0·0474 by 0·0118 mm.

II. Microsclere. 4. *Sigmaspire*, 0·0118 mm. long.

Colour.—Cream-white.

Habitat.—Station 163A, off Twofold Bay, Australia, April 4, 1874; lat. 36° 59′ S., long. 150° 20′ E.; depth, 150 fathoms; bottom, green mud.

Remarks.—Four specimens of this sponge were dredged, the largest, of an irregular ellipsoidal form, measures 21 by 18 by 15 mm., the smallest is subspherical, and about 9 mm. in diameter. The sponge is soft to the touch, with a velvet-like surface. The oscules are very small, from 0·5 to 2 mm. in diameter, in one specimen none were seen, and a series of sections failed to reveal any.

The cortex (Pl. II. figs. 1, 2) 0·4 mm thick, is a collenchyma, vesicular just below the outer epithelium and cavernous further in, the lowest layer of the cortex, one-quarter the thickness of the whole, is markedly fibrous, the fusiform cells running tangentially. Spicules disposed some tangentially, and others crossing these obliquely, are irregularly scattered through the inner layer of the cortex. The subdermal cavities excavate the cortex between the radiating spicular pillars, they are about 0·2 to 0·3 mm. high, and the thin roof which covers them is perforated by numerous pores.

The floor of the subdermal cavities is furnished by the fibrous layer of the cortex, through this they communicate with the incurrent canals by passages surrounded by concentrically arranged myocytes.

The mesoderm of the choanosome is a granular collenchyma or early form of sarcenchyma. The flagellated chambers differ considerably in size, measuring from 0·035 to 0·048 mm. in diameter. The incurrent canals communicate with them directly, the prosopyle measuring from 0·0158 to 0·0276 in diameter; they are sometimes eurypylous, sometimes aphodal, the apopyle is about 0·0118 mm. in diameter; an aphodal canal in one very clear instance measured 0·02 mm. in length, its diameter being that of the apopyle. A choanocyte with collum extended measured 0·0118 mm. in length, and 0·0035 mm. in diameter at the base.

Sperm clusters occur but rarely, one oval mass, 0·05 mm. in diameter, was met with; the spermatozoa were seen as spherical granules without tails, they measured 0·0015 to 0·002 mm. in diameter.

The skeleton consists of radiating spicular fibres, crossed by a great number of loosely scattered oxeas, which lie tangentially and obliquely; the skeleton of the cortex is produced simply by the extension of this skeleton into it.

The radiating spicules emerge from the surface without forming conules; the pro-

jecting spicular ends, which produce the pilosity of the surface, are the cladi of protriænes and anatriænes, and the points of oxeas, but chiefly the cladi of protriænes; they do not extend, as a rule, much more than 0·25 mm. beyond the surface, though, judging from broken rhabdomes, some probably extend much further.

The cladi of most of the projecting protriænes measured *in situ* are 0·142 mm. long by 0·006 mm. in diameter, the length of the chord is 0·108 mm.; these dimensions are below those given in the description of spicules, which, however, were taken from selected largest examples.

Chrotella macellata,[1] Sollas (Pl. IV. figs. 1–22).

Chrotella macellata, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 181, 1886.

Sponge (Pl. IV. figs. 1, 2) subspherical, depressed, with a flat base; oscules more than one in number, each leading into a large cloacal chamber; upper surface minutely hispid, lower surface coarsely so, by the projection of spicules to a longer distance. Ectosome a cortex, not differentiated into two layers; choanosomal mesoderm sarcenchymatous, flagellated chambers small, aphodal.

Spicules.—1. Megascleres. 1. *Oxea* of the spicular fibres isoactinate, fusiform (Pl. IV. fig. 3) with similar sharp ends, which sometimes however become rounded off. Length 5·7 mm., breadth 0·055 mm.

2. *Oxea* of the interspaces between the spicular fibres, smaller than the preceding (Pl. IV. fig. 10), somewhat curved, and only very slightly fusiform.

3. *Protriæne* (Pl. IV. figs. 8, 15) with short stout cladi, highly porrectate, measuring 0·079 by 0·0197 mm.; rhabdome but very slightly less in diameter immediately below the cladome than in the middle, thence tapering gradually to a sharp but not filiform termination, 7·95 mm. and over, by 0·0276 mm.

4. *Protriæne* (Pl. IV. fig. 14) with longer cladi than No. 3, 0·23 mm. long by 0·0197 mm. thick, less porrectate; rhabdome also shorter, 2·5 by 0·0237 mm., and tapering from immediately below the cladome, rather rapidly, to an almost filiform termination.

5. *Prodiæne and promonæne* (Pl. IV. figs. 4, 5). Derived from the preceding by reduction in the number of cladi. The rhabdomes of these measure 3·49 by 0·0316 mm.; the cladi of the prodiæne 0·44 by 0·0316 mm., and that of the promonæne 0·58 by 0·0316 mm. These spicules present a singular appearance, owing to the relatively large size of their cladi and the sudden tapering of the rhabdome.

6. *Trichodal protriæne* (Pl. IV. figs. 6, 7). Occurring in bundles in the cloaca and elsewhere.

7. *Anatriæne* (Pl. IV. figs. 9, 13). The cladi are 0·059 mm. long by 0·0138 mm.

[1] μάκελλα, ἡ, a pick-axe with one point.

in diameter; the rhabdome 6·5 by 0·0158 mm., is nearly cylindrical for a considerable distance below the cladome, and ends in a filiform termination.

II. Microscleres. 8. *Sigmaspire of the choanosome.* This is of the usual form; 0·012 to 0·016 mm. long.

9. *Toxospire of the cortex* (Pl. IV. figs 11, 12). This is a sigmaspire modified by continued growth in a spiral direction; it has the form of a widely open helix of nearly two turns with a variable spiral angle. Its length is from 0·03 to 0·04 mm.

Colour.—Dark grey.

Habitat.—Station 208, off Manila, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; depth, 18 fathoms; bottom, blue mud.

Remarks.—Four specimens of this sponge were trawled; all more or less hemispherical or dome-shaped with a flat base. The largest measures 42 mm. by 38 mm. along its horizontal diameters, and 32 mm. in height.

The oscules (Pl. IV. fig. 2) are borne on the summits of more or less conical eminences on the upper surface of the sponge; the smallest specimen bears two, the largest six, having an average diameter of somewhat under 2 mm. They lead into a large cloacal chamber, the wall of which is perforated by numerous small round or oval apertures, giving it a cribriform appearance. Trichodal protriænes lie in bundles in the wall of the chamber and project obliquely forwards, surrounding the pores with their cladomes.

Skeleton.—The long spicules (1, 3, 4, 5, 7) are collected into radiating fibres, the triænes appearing at the distal ends. From the terminal sheaf of the fibre the protriænes with widely diverging cladi (4, 5) project their cladi into the cortex (Pl. IV. fig. 18), thus contributing essentially to its support. The cladomes of many of the anatriænes, indeed almost all, are also embedded in the cortex. The highly porrectate protriænes (3) project beyond the surface as hispidating spicules. The numerous smaller oxeas (2) lie irregularly scattered through the cortex, crossing one another in directions oblique to the general surface, but more nearly parallel than perpendicular to it. Around the oscule the spicular fibres project in a kind of fringe; these fringing spicules are chiefly protriænes. The sigmaspires are scattered generally through the choanosome, but are most abundant in the walls of the canals and cloacal chambers.

The toxospires of the cortex are most abundant beneath the external epithelium, where they form a dense layer. Outside the sponge, covering the epithelium, is a quantity of granular debris, in which numerous deciduous toxospires occur. The crowding of the toxospires towards the exterior, and the presence of deciduous examples beyond it, point to an outward movement and final extrication of these spicules.

Ectosome.—Beneath the external epithelium the cortex consists of a layer of collenchyma, very difficult to analyse, partly on account of its complexity, partly by reason of the slight but numerous variations which it exhibits in different regions. The

gelatinous matrix presents, besides collencytes and vesicular cells, numerous long fusiform cells, some running more or less parallel with the surface, others quite irregularly. In some places small, round, granular cells, 0·006 mm. in diameter, occur crowded together to the exclusion of other elements; in some the vesicular, and in others the fusiform cells predominate.

The incurrent canals burrow irregularly through the cortex; they are irregular in their course and in their form; they are swollen into vesicles of various sizes, irregularly branched and broken up by trabeculæ; they thus give to the collenchyma a cavernous character which adds to the difficulty of describing it.

The collenchyma is continued from the cortex inwards along the spicular tracts, undergoing certain modifications, of which the most important is the appearance of conspicuous cells, which at once arrest the attention, partly on account of their comparatively large size, and partly because of the regular manner in which they lie one after another in linear series upon the sides of the spicules, and apparently in immediate contact with them. These cells, although evidently all of one kind, are of such various forms and characters that they are not easy to describe in a few words. They are more or less rounded masses, prolonged into filmy or fibrous processes, finely granular, staining somewhat deeply, with an average diameter of 0·016 to 0·02 mm. Some have a columnar form, seated by a flat base on a spicule, and produced at the opposite end into a short tail-like process; the columnar body in one case measured 0·024 mm. in length, the tail 0·016 mm. The outer part of the cell loses in many cases its property of staining deeply, and the change thus begun appears to extend inwards till it affects the whole cell. This appears to point to exhaustion with age, and suggests a glandular, rather than a nervous function for these cells. They lie tolerably close together; in one case I counted six in a row 0·13 mm. long, in another fourteen in a row 0·32 mm. long. I could not determine whether they formed a sheath or not to the spicule.

Cloaca.—As the cortex approaches the margins of the oscule, round or oval, deeply-staining granular cells, 0·012 mm. in diameter, appear within the collenchyma, and increase in numbers, till a tissue, consisting of these and some fusiform cells, embedded in collenchyma results (Pl. IV. fig. 19). This tissue, invested of course by epithelium, is continued from the margins of the oscule as a lining, 0·475 to 0·56 mm. thick, to the whole of the cloacal chamber. The oxeas of the cortex disappear at the margin of the oscule, a little before the lining tissue of the cloaca commences, and the toxospires, at the same time or a little later, *i.e.*, nearer the cloaca, are replaced by ordinary sigmaspires.

The choanosomal tissue intervening between the cortex and the walls of the cloaca, is converted into collenchyma similar to that of the cloacal lining, but distinguished by the predominance of the myocytes which form the greater part of it. This modification of the choanosome extends for a distance of about 0·1 mm. inwards from the margin of the oscule.

Around the pores in the cloacal walls myocytes are concentrically arranged, and stellate cells occur close to their margins, which send a process to the epithelium on the one hand, and one or two processes inwards in the opposite direction.

Sexual Elements.—Spermatozoa.—Around the lower end of the cloaca the choanosome is densely crowded with sperm-clusters, each lying in a distinct cavity, which it does not fill, owing no doubt to shrinking produced by immersion in spirits. They are of round, oval, or sometimes irregular shape, and vary from 0·006 by 0·012 mm. to 0·047 by 0·075 mm. in diameter. Most of them consist of small spherical cells, about 0·004 mm. in diameter, with a very obvious nucleus and a dark-stained nucleolus. They are therefore not mature, though some few instances occur in which the constituent cells are of smaller size, and appear to be produced into a tail. A cover-cell is certainly not present, but the wall of the containing cavity is lined by epithelium, and the adjacent mesoderm stains more deeply in its immediate neighbourhood than elsewhere.

The sperm-clusters are so numerous that they reduce the surrounding mesoderm to little more than a trabecular network, in which flagellated chambers are only rarely seen. It would therefore seem that we have here a specialised sperm-bearing region or rudimentary testicular tissue, recalling the specialised ova-bearing region or rudimentary ovary which Schulze discovered in *Euspongia*.

Ova.—Certain remarkable cells of great size and complexity occur here and there in cavities of the choanosome; their true nature is doubtful, and if not ova, they must be regarded as parasites. They present numerous variations both in form and structure. Some suggest a resemblance to gigantic Rhizopoda, extending into large branched pseudopodial extensions (Pl. IV. fig. 22), which enter the surrounding tissue, and lose themselves in it. Others (Pl. IV. fig. 21) present a round or oval outline, varying from about 0·1 mm. to 0·2 mm. in diameter. The nucleus is an oval body, 0·0395 mm. long by 0·0276 mm. broad, with evenly and finely granular, faintly-staining contents, enclosed in a well-defined limiting membrane. It always presents at least one well-marked, highly refringent, non-granular, deeply-stained, spherical nucleolus, varying from 0·0039 to 0·0118 mm. in diameter. Often, however, two or three nucleoli are present, and in one instance no less than six were counted. Outside this nucleus, immediately next the nuclear membrane, succeeds a layer of dense, darkly-stained protoplasm; then a clearer zone follows, in which a vesicular structure can sometimes be made out; outside this again is a dense, darkly-stained margin, which is sometimes so distinct as to look like a second nuclear envelope; finally, outside this succeeds the general mass of external protoplasm. While the structure just described is of most common occurrence, cases also occur in which it becomes simplified, the nucleus for instance simply lying in protoplasm, which is rather more deeply stained immediately next to it than elsewhere.

In general character the mass of external protoplasm of these cells is finely granular

and deeply staining, but it is not simply a granular mass, but a complex of discrete parts, each of which in a manner simulates the structure of a cell. Thus in many cases we may readily discern fine darkly-stained fibrils radiating through the protoplasm towards the periphery of the cell, and in fortunate cases these can be traced in continuity with small columnar or stellate bodies, within which an oval vesicular space containing a small deeply stained granule can be distinguished. In other cases oval vesicles with a distinct wall, and not merely vesicular spaces, can be distinguished, and within these granular material with one granule larger than the rest is to be seen. In fig. 21, Pl. IV., numerous columnar pseudocells are shown with their bases adjacent to the nucleus and their filamentous extremities directed peripherally. The structures shown in this figure are those which it was found possible to trace with a camera; the rest of the cell left blank presented similar appearances, but hardly sharply defined enough to be traced. Small deeply stained amœboid cells, about 0·03 mm. in diameter, also occur in the choanosome, and appear to be young forms of the cells just described. If so, the latter are in all probability ova.

Parasitism. — 1. *Ophiurids.* Each cloaca in all four specimens of the sponge harbours an individual belonging to some species of Ophiurid. This Ophiurid, though small compared with some other species, is large compared with the size of the cloaca, which it nearly fills. Its disc is 5 mm. in diameter, and its arms when uncoiled 45 mm. long; they are recurved over the aboral surface of the disc, leaving the mouth exposed and the teeth projecting. Its position within the cloaca is rather to one side of it, within a faintly marked recess. The oscule of the chamber is large enough to allow of the egress of the tenant, but the rat-trap-like arrangement of the fringing spicules would seem to preclude return, and, as the Ophiurid does not feed on the sponge itself, it becomes a curious problem to discover by what means it obtains its food.

2. *Worms.* Numerous encysted worm-like parasites in various stages of development are common on the choanosome.

Cinachyra,[1] n. gen.

The cortex is not excavated by subdermal cavities; oxeate spicules traverse it radiately. The incurrent and excurrent openings are confined to special flask-shaped recesses. The mesoderm of the choanosome is a collenchyma; the chamber system is eurypylous.

Cinachyra barbata, Sollas (Pls. III., XXXIX.).

Cinachyra barbata, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 183, 1886.

Sponge (Pl. III. fig. 1) a subspherical or subcylindrical body seated on a dense mass of tangled spicules. Oscules large and numerous, with a conspicuous sphinctral margin,

[1] κιν-αχύρα, ἡ, a kind of bag or sieve for bolting flour.

rare on the summit, chiefly distributed in an irregular zone round the sides of the body. Surface hirsute, with obliquely projecting spicules; projecting ends longer over the sides than the summit of the sponge.

Spicules.—I. Megascleres. 1. *Somal oxea*, large (Pl. III. fig. 4), fusiform, sharply pointed, straight, or curved in correspondence with the curvature of the spicular fibres, 8·03 by 0·071 mm.

2. *Cortical oxea* (Pl. III. fig. 7) smaller than the preceding, cylindrical or fusiform, usually curved, obtusely pointed, 0·892 by 0·0355 mm.

3. *Protriæne* (Pl. III. fig. 6). A somewhat fusiform rhabdome, 0·0197 mm. wide just below the cladome, increasing to 0·0296 where widest, and then tapering to a filiform extremity; its length is 13·21 mm. The cladi, usually three in number, but sometimes reduced to two or even one, are conical, 0·1776 mm. long, and 0·016 mm. broad at the base.

4. *Trichodal protriæne.* A slender filiform rhabdome, and three cladi usually unequal in length. Dimensions:—Rhabdome 0·13 by 0·0039 mm.; cladi very variable, two shorter and unequal 0·016 mm. long, one longer from 0·0237 to 0·031 mm. long.

5. *Anatriæne* (Pl. III. fig. 5). Confined to the lower part of the sponge-body; the rhabdome long, somewhat fusiform but nearly cylindrical, terminating at the proximal end in a filiform extremity; cladome variable in shape, axial fibre of shaft prolonged into it; cladi usually much recurved, sometimes so much so as to become parallel with the rhabdome. Dimensions:—An anatriæne with its cladome embedded in the cortex gave the following measurements:—Rhabdome 19·6 by 0·0316 mm.; cladi 0·215 by 0·0276 mm., chord 0·2 mm.; length of cladal end of the rhabdome 0·059, extension of axial fibre into it 0·0119 mm. An example from the anchoring filaments of the base gave:—Rhabdome 40 mm. by 0·0237 just below the cladome, lower down 0·0158 mm. in diameter, from this increasing to 0·0235, and finally attenuating to a filiform extremity; cladi 0·087 by 0·0197 mm., chord 0·09 mm., length of the cladal end of the rhabdome 0·0474 mm. The cladome of this specimen is smaller than the average, a more usual size for the cladi is 0·1026 by 0·0158 mm., chord 0·118 mm.

II. Microscleres. 6. *Sigmaspire* (Pl. III. fig. 8) of the usual form, 0·0118 to 0·0156 mm. long.

7. *Globules;* accessory or accidental forms, 0·0535 mm. in diameter.

Colour.—Ashen-grey.

Habitat.—Station 149B, off Royal Sound, Kerguelen, January 17, 1874; lat. 49° 28′ S., long. 70° 30′ E.; depth, 25 fathoms; bottom, volcanic mud.

Station 149C, Balfour Bay, Kerguelen, January 19, 1874; lat. 49° 32′ S., long. 70° 0′ E.; depth, 60 fathoms; bottom, volcanic mud.

Remarks.—Over sixty specimens of this remarkable sponge, the only species of the genus, were dredged off the shores of Kerguelen. They vary considerably

in shape; the smallest is a prolate ellipsoid, 2·85 by 2·1 mm. in size, the next a little larger is egg-shaped, about 5 mm. high by 4 mm. in width, both are provided with the characteristic oscules of the species, but without anchoring filaments; these are present, however, in specimens but very slightly larger (Pl. III. figs. 2, 3); and by the time the sponge has attained a length of 20 mm., they are already matted together into a compact basal lump. The largest specimen in the collection presents a somewhat cylindrical body, 70 mm. high by 85 and 70 mm. in breadth and width, it is seated on a basal spicular mass 50 mm. high, and 100 by 70 mm. in breadth and width; another large specimen is 47 mm. high, 52 mm. wide, and 43 mm. broad; with a basal mass 29 mm. high by 56 mm. broad and 49 mm. wide. In a few large specimens the basal mass is absent, and the anchoring spicules confined to a few ragged tufts; in one case a sponge with the form of a long prolate ellipsoid presents scarcely a trace of roots.

On cutting open the sponge a yellowish choanosome is exposed, surrounded by a whitish cortex, the thickness of which varies somewhat in different specimens, but on the average, in full-grown forms, is about 1·75 mm.; near the base it is produced into conical thickenings around the anchoring fibres as they pass out through it.

The spicular fibres proceed from a spicular core or so-called nucleus, which is situated excentrically within the choanosome, so as usually to lie much nearer one side of the sponge than the other. The core is a somewhat spherical mass of radiating spicules, with very little associated tissue, and consequently of great hardness; as the spicular fibres leave the core they become flexed somewhat sharply, particularly so on that side of the core which lies nearest to the exterior of the sponge; they then continue in a spiral course, but with a much gentler curve towards the exterior, from which they emerge usually more or less obliquely. The obliquity of emergence is often diminished by a slight change in the direction of curvature, sometimes amounting to a reversal, tending to bring the spicules into a position more nearly normal to the surface. The spiral curvature of the fibre is often so great that in a sponge of 30 mm. radius a single fibre may attain a length of 50 mm. It is different in amount in different directions within the sponge; being least, and indeed sometimes vanishing, along an axis which may, but which more frequently does not, correspond with the axis of symmetry of the sponge, and attaining a maximum in a plane at right angles to this. We may most readily picture this arrangement by supposing the spicular fibres to have originally a radiate direction, and subsequently to become twisted by a rotation of the cortex, carrying with it their outer ends, around any axis passing through the sponge.

The downwardly directed fibres of the sponge are usually less twisted than those ascending, so that they emerge normally to the surface to form the anchoring roots.

The direction of the spiral curvature of the fibres is sometimes left- and sometimes right-handed, in nineteen cases it was found to run counter to the hands of a watch, and in twenty-two with them; in three other cases, so far as one could judge from the direc-

tion of the externally projecting spicules of the fibres, the spirals had not all a common direction, but on one side were left, and on the other right-handed; where the change in direction occurs the spicules project at right angles to the surface, instead of obliquely, and are differently arranged around the oscules which occur in this region, for instead of forming a fringe, which lies obliquely over the oscule on one side and slopes obliquely away from it on the other as is the case usually, they here surround the margin of the oscule radiately, diverging from it on all sides, like the feathers around the eye of an owl.

The spicular fibres are composed of the large oxeas (1) which are sometimes much curved in accordance with the curvature of the fibres. Oscar Schmidt has suggested[1] that the fusiform shape of the oxea in the Tetillidæ has produced the spiral course of the fibres; this is obviously not the case, the curvature of the fibres is due to some other cause, and may influence, but is not determined by the shape of the spicules.

At the peripheral ends of the fibres protriænes appear and project beyond the cortex; indeed these are the chief hispidating spicules of the sponge, anatriænes scarcely appearing except towards the base, where they become the prevailing projecting forms, and radiate in long brushes downwards amidst the matted mass of sand and spicules which furnish a solid foundation to the sponge. The smaller oxeas, though characteristic of the cortex, are not confined to it, but also occur in the choanosome just below; probably they are formed in the choanosome and pushed out from it into the cortex.

Next to the massive spicular base the oscules are the most striking feature of the sponge; they are very conspicuous, large, and numerous; in one small specimen, 19 mm. high by 23 mm. broad, twenty-three oscules were counted, the largest 5 mm. in diameter; of course in larger specimens they are correspondingly more numerous, and may attain an outside diameter of 10 mm.

They are chiefly confined to the sides of the sponge and are more numerous on one side than the other, that namely which lies most remote from the spicular core. Thus of the twenty-three oscules in the case just quoted, five only can be seen at once on one side of the sponge, and as many as twelve on the other.

The margin of the oscule is a smooth, white, shining ring, very conspicuous amidst the dark grey forest of surrounding spicules (Pl. III. fig. 1; Pl. XXXIX. fig. 1). It forms the outer end of a cylindrical or oscular tube which extends through the cortex and then expands into the flask-shaped cloacal chamber. The walls of the oscular tube are solid, imperforate, and thicker than those of the cloacal chamber, which communicates through sieve-like groups of pores with the excurrent canals. These are wide open tubes, which as they approach the cloaca become subdivided again and again by numerous trabeculæ, till they are reduced to sinuses, which surround the immersed side of the cloacal wall, radiating away from it in all directions. The free surface of the cloacal chamber is raised into a polygonal network of rounded ridges, produced by fibrous

[1] Spong. Atlant Gebiet., p. 8, 1872.

strands, which branch and unite again in the thickness of the wall. In the depressed areas mapped out by these ridges, the pore groups are situated.

On approaching the lower margin of the oscular tube, the ridges affect a longitudinal direction, and expanding on each side as they enter it, give to the outermost row of depressed areas the form of arched recesses.

No pores or intercortical cavities are to be detected over any part of the cortex, although they have been searched for in several sections of entire sponges; it would appear therefore that the oscules and cloacal chambers, so-called, are some of them incurrent in function, and in accordance with this we find, proceeding from some of the cloacal chambers, subcortical canals, occupying the same relative position in this sponge that the undoubted incurrent canals do in *Disgringa dissimilis* (see Pl. XLI. fig. 3).

Notwithstanding this supposed difference in function we shall continue to speak of the flask-shaped recesses and their openings to the exterior, whether excurrent or incurrent, as cloacal chambers and oscules.

The minute structures of the "flasks" has been very carefully studied in transverse, longitudinal, and tangential sections, and by teasing.

Oscular Tube.—The wall of the oscular tube (about 0·64 mm. thick in average-sized examples) is mainly composed (Pl. XXXIX. fig. 2) of concentrically arranged myocytes, traversed by a few longitudinal strands of similar cells, from which branches arise at intervals and proceed towards the free face in a radiate direction; as they do so their constituent cells, diverge from each other upwards and downwards, giving them a fan-shaped outline in section. The concentric myocytes represent the fibrous cortex somewhat modified; in the immediate neighbourhood of the oscular wall the cortex is a collenchyma with tangentially disposed fusiform fibre-cells running through it in various directions; by the reduction of the collenchyma to an almost imperceptible residuum, and the consequent approximation of the fusiform cells, which at the same time fall into a concentric arrangement, the chief mass of the oscular tube results. The longitudinal fibres are derived from the walls of the cloacal chamber, but these are simply a part of the cortex invaginated, with fibres of fusiform cells running tangentially through them just as in the rest of the cortex.

The epithelium of the cortex is continued inwards, lining the interior of the flask-shaped recess; below it in the case of the oscular tube is a layer of tissue, about 0·08 mm. thick, sometimes less, which is of considerable interest, since it presents in places structures which are similar to sense-cells (Pl. XXXIX. fig. 8). These are fusiform, finely granular cells, more deeply stained than the adjacent tissue; they are usually somewhat swollen in the middle, where an oval nucleus with a spherical darkly-stained nucleolus is situated; the outer end is elongate, conical, with a rounded point, but no apparent sense-hair, it lies either immediately below the epithelium or projects between the epithelial cells, at the inner end it terminates in one or two fine

filaments; side by side with these fusiform cells, cylindrical forms occur, with a broad outer end, and an inner end produced into long tail-like processes not more than two in number. It was not found possible to trace these processes into connection with any other cellular elements. These elongate cells are not uniformly distributed below the epithelium, but occur in patches, which can be generally recognised by a more than usually deep stain; frequently they converge towards the middle of the patch. Sometimes they are found below an even surface of epithelium; sometimes in ridges, which look like papillæ, but which are probably only wrinkles produced by the contraction of the muscular oscular tube. Immediately below this outermost layer follows a tissue-complex which is somewhat difficult to interpret. Most conspicuous and lying nearest the surface are little roundish granular bodies, 0·004 to 0·005 mm. in diameter, with a nucleus and nucleolus, lying in distinct cavities of a stained material. They appear to be the most visible portion of cells which are extended into processes difficult to distinguish. Lying deeper are granular irregularly branching cells, which look like collencytes. Next to these follows the layer of concentric myocytes. Scattered irregularly through the tissue of the oscular tube are numerous oval cells about 0·015 mm. in diameter, consisting of granules 0·003 mm. in diameter, some of which stain much more deeply than others.

The detailed structure of the layer of concentric myocytes is best made out in teased specimens mounted in glycerine. Each myocyte (Pl. XXXIX. fig. 9) is then seen as a fusiform thread-like cell, 0·4 mm. long by 0·0035 mm. thick; in the middle is an elongated oval vesicular nucleus, 0·0118 by 0·003 mm., containing a minute nucleolus, and surrounded by granular protoplasm, which extends 0·04 mm. along the axis of the cell on each side of it. The rest of the cell consists of structureless stained material. Associated with the myocytes are abundant collencytes (Pl. XXXIX. fig. 10) produced into very numerous branching thread-like processes, which unite among themselves into an intricate network which pervades the whole muscle. Not only do they unite with one another, but with the myocytes also, so that all the constituents of the muscular mass are in protoplasmic continuity. Though this structure is best made out in teased specimens it can also be traced in tangential sections (Pl. XXXIX. fig. 5), appearing particularly evident at those places where the pillars of fibre from the cloacal chamber enter the muscular tube of the oscule; the constituent myocytes of these fibres diverge to the right and left on entering this tube, and thus render the collencytes readily visible. From the foregoing description it would appear not impossible that a communication extends from the subepithelial columnar cells, through the underlying collencytes, to the collencytes of the muscular mass, and thence to the myocytes themselves, and thus the stimulus provoked by a foreign body touching the sides of the oscule, might extend to the muscle and bring about its contraction.

Cloacal Chamber.—The walls of this chamber (Pl. XXXIX. figs. 1–4) are formed

of a middle layer of myocytes, having collencytes associated with them, as in the oscular tube, and superficial layers of collenchyma containing similar cellular elements to those which occur below the epithelium of the oscular tube, excepting the subepithelial columnar and fusiform cells, which are here only to be observed rarely and as isolated examples. The muscle-fibres may be distinguished as main fibres and their branches, the former surrounding the larger oval or polygonal areas of the wall, the latter subdividing them into still smaller areas. In the centre of the smallest areas is a circular pore or short tube, which opens freely into the surrounding sinuses of the excurrent canals. Each pore is surrounded by concentrically arranged myocytes, which are crossed by fusiform cells running radiately (Pl. XXXIX. fig. 4). The outer ends of these cells unite with the epithelium, the constituent cells of which are very clearly indicated by the outward dome-like bulging over the nucleus, or they may apparently sometimes project beyond, though I could by no means be sure of this, in a fine short bristle-like process. From the nucleus to its outer extremity, or about half the length of the cell, is a distance of 0·04 mm., as seen in portions of the wall viewed *en face* mounted in glycerine. In transverse sections these cells are not often seen, as they are not numerous, from ten to twenty to each pore, when visible their inner ends can be traced into apparent continuity with adjacent collencytes. Trichodal protriænes in dense bundles lie within the walls of the chambers, running longitudinally and obliquely, so that their cladomes project into the cavity of the chamber, bristling around the pores (Pl. XXXIX. fig. 2).

The Cortex (Pl. III. fig. 10).—The thickness of the cortex in full-grown specimens varies from about 1·25 to 1·5 mm., the outer part (Pl. III. figs. 11, 12) from 0·2 to 0·4 mm., below the epithelium consists of collenchyma with fusiform cells and granule cells strewn through it; the rest is mainly composed of fusiform cells variously orientated in planes parallel to the surface. The sigmaspires occur chiefly just below the epithelium; the oxeas crowd the exterior half, so that between the main spicular fibres, the lower part, for a thickness of 0·6 mm., is devoid of spicules.

The Choanosome (Pl. III. fig. 13).—The mesoderm is a collenchyma, which is finely granular about the flagellated chambers, but of the usual character when it accompanies the spicular fibres. The flagellated chambers have an average diameter of about 0·0395 to 0·043 mm.

The Young Sponge (Pl. III. figs. 2, 3, 9).—In the smallest specimen of the collection (under 3 mm. in diameter), the cortex is from 0·08 to 0·16 mm. thick, and the oscular tubes and cloacal chambers are not yet completely differentiated. The latter are represented by a part of the cortex, which is thinner here than elsewhere (0·016 mm. thick), perforated by numerous pores, and curved inwards below the general level of the sponge. Thus in their inception the cloacal chambers are simply poriferous areas of the cortex. The pores open into sinuses (they can hardly be called canals), left by the folding of the choanosome. The oscular tube is represented simply by the margin of the general

cortex where it surrounds the poriferous area. It already presents, at the entrance to the poriferous area, cells remarkably like sense-cells (Pl. XXXIX. figs. 6, 7). In the next smallest specimen (Pl. III. fig. 9), over 4 mm. in diameter, the walls of the cloacal chamber are thicker, more deeply invaginated, and the whole structure is essentially similar to that of the adult oscule and chamber. The spiral arrangement of the spicular fibres is already well developed in the youngest specimen, and the young oxeas are bent in exact accordance with the curvature of the spiral, which is not much more than one spicule in length; thus showing that the spiral is not due to the form of the spicules, but the form of the spicules to the spiral; both are caused by a spiral growth of the sponge.

Craniella, O. Schmidt.

The cortex is differentiated into an inner fibrous layer traversed radiately by cortical oxeate spicules, and an outer collenchymatous layer, excavated by subdermal cavities. The choanosomal mesoderm is a sarcenchyma; the chamber system aphodal.

Craniella simillima (Bowerbank) (Pl. II. figs. 5–20; Pl. IV. figs. 23–31).

Tethea simillima, Bwk., *pars*, Proc. Zool. Soc. Lond., p. 15, pl. iii. figs. 7–8, 1873 (South Seas).
Craniella Bowerbankii, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 181, 1886.

Sponge subspherical, surface conulose; a single oscule at the summit, its position indicated by the greater length of the conules which project around it; base distinguished by a general pilosity and absence of conules.

Spicules.—I. Megascleres. 1. *Somal oxea*, anisoactinate (Pl. II. fig. 6; Pl. IV. fig. 24), fusiform, maximum diameter nearest the distal end; proximal end highly attenuated; 3·26 by 0·047 mm.

2. *Cortical oxea* (Pl. IV. fig. 27), fusiform, 1·4 by 0·04 mm.

3. *Protriæne* (Pl. II. figs. 7, 8, 14, 15; Pl. IV. figs. 26, 28). Rhabdome slightly narrower just below the cladome than a little further down, attenuated to a filiform distal end; rhabdome 5·12 by 0·02 to 0·024 mm.; cladi 0·12 mm. long, chord 0·06 to 0·07 mm.

4. *Anatriæne* (Pl. II. figs. 9, 10, 16, 17; Pl. IV. figs. 25, 29). Rhabdome at first nearly cylindrical, thin, tapering to a filiform extremity; cladome almost conical, somewhat pointed in front; axial fibre of rhabdome continued into it 0·016 mm. past the origin of the cladal axes; cladi conical, rather short; rhabdome 5·8 by 0·02 mm.; cladi 0·058 mm. long, chord 0·08 mm.

II. Microscleres absent.

Colour.—Ochreous-white, or cream-coloured.

Habitat.—Station 163B, Port Jackson, Sydney, June 3, 1874; depth, 35 fathoms; bottom, hard ground; bottom temperature, 63°. (Type specimen.)

Var. *α*. Samboangan, Philippine Islands.

Var. *β*. Station 186, between Cape York and the Arrou Islands, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; bottom, coral mud.

Remarks.—Bowerbank's description of *Tethea simillima*, Bowerbank, *loc. cit.*, is a medley of the characters of two specimens belonging to different species, and indeed different genera; one, as can be readily seen from his illustrations, a cortical sponge like *Craniella* (figs. 7, 8, *loc. cit.*), and the other (fig. 6, *ib.*) non-corticate and apparently resembling *Tetilla*. Now a species has no claim to recognition unless it is described so that it can be distinguished, and instead of spending time on a discussion as to which of these two species the term *simillima* should be applied, I thought it safer when drawing up my Preliminary Report to suppress the name altogether; though I had but little doubt as to the identity of the corticate sponge with *Craniella bowerbankii*. Since then I have had an opportunity of examining one of the two types on which Bowerbank founded his species, and the other is not to be found; it happens that the still existing type which is preserved in the collection of the Royal College of Surgeons is specifically identical with the sponge under description, and to save confusion I now return to Bowerbank's name. Bowerbank does not give measurements of the spicules of this sponge, but as he states the magnification of his drawings it is possible to get approximate dimensions from these; thus I find the large oxeate spicule measures 3·15 by 0·031 mm., and is therefore much the same size as that in our specimens.

Craniella simillima closely resembles *Craniella carteri*, from which it is distinguished by the absence of pigment-glands in the outer layer of the cortex.

Three specimens of this sponge were obtained, one from Port Jackson, Sydney, 20 mm. high by 23 and 16 mm. in diameter; one from Samboangan, Philippine Islands, 29 mm. high by 27 mm. in diameter, and the third from Torres Strait, 20 mm. high by 15 mm. in diameter. In general appearance the specimens from Samboangan and Port Jackson are most similar, the Torres Strait specimen differs in the character of the conules, which are more slender and more numerous than in the other specimens, the projecting spicules of the conules also extend further from the surface than in those specimens.

Similar differences exist between the other two specimens, that from Port Jackson being distinguished from that of Samboangan by coarser and more rigid conules.

Differences occur also in the size of the spicules of all three specimens, but these are not sufficiently great for specific distinction. The measurements are as follows:—

Specimen from	Somal oxea.	Protriæne.	Anatriæne.
Torres Strait, . . .	2·85 × 0·028	4·65 × 0·016	5·355 × 0·016
Port Jackson, . . .	3·26 × 0·035 / 0·047	4·65 × 0·024 / 5·16 × 0·02	5·8 × 0·02
Samboangan, . . .	3·37 × 0·044 / 0·047	4·65 × 0·016	6·63 × 0·012

The specimens are arranged in the Table in the order of their size, that from Torres Strait being the smallest.

The structure of the cortex is that of the genus; the inner layer of the cortex varies from 0·8 to 1·9 mm. in thickness, the outer layer from 0·16 to 0·8 mm., increasing to 1·6 mm. in thickness, where it forms the tissue of the conules; and even to 2·7 mm. in the region of the oscule where the conules are longer.

The outer layer of the cortex consists of cavernous collenchyma, the cavities usually so numerous and large as to reduce the tissue to the thinnest possible films. The matrix, in addition to containing stellate cells (collencytes), is crowded with depressed oval cells, bounded by a sharply defined outer wall, and containing a vesicular nucleus with a spherical nucleolus, the former surrounded by granular protoplasm from which thin threads extend and pass into a protoplasmic film coating the inside of the wall. These cells occur crowded together where the collenchyma forms a dense tissue around the margin of the oscule, and are scattered parallel to the surface through the walls of the cavities of the cavernous collenchyma. Fusiform cells also are numerous in the collenchyma, especially where it forms the roof to the subdermal cavities, and the tissue of the conules.

The outer layer of the cortex has the usual structure, but the cortical oxeas appear to lie more regularly radiate in it than in *Craniella cranium*, their distal ends extend into the collenchymatous floor of the subdermal cavities, and they pass through the conular pillars up to the skin.

The subdermal cavities are either simple open chambers, often extending continuously within the outer layer of the cortex from one conule to another, or they may be broken up by irregular trabeculæ into a number of small communicating cavities. The roof is formed by the skin which extends between the conules and is pierced by numerous pores, which either open into the cavity directly, or, when the roof is thick, by short canals.

The oscule is surrounded by concentric myocytes; several excurrent canals pass through the inner cortex to open into the cavities of the outer cortex, and these finally discharge by the oscule.

The choanosome is a sarcenchyma, the flagellated chambers measure about 0·028 by 0·036 mm. on the average, but are sometimes longer, 0·028 by 0·0434 mm. The choanocytes are 0·0039 mm. in diameter at the base, and about 0·007 mm. long.

Development (Pl. II. figs. 18, 19).—The type specimen is crowded with embryos in an advanced stage of development, they are somewhat lenticular bodies, with a flattened base and convex summit, about 1·75 mm. in horizontal diameter, and 0·8 mm. high. So numerous are they that, from the upper half of a single cut face of the sponge, I extracted no fewer than thirteen entire examples. In colour they are dark grey; the surface is raised into conules.

Ectosome.—The ectosome is already highly differentiated, and recognisable at once as that of a corticate sponge. It consists of a thick inner layer, underlying the extensive subdermal cavities, and a thin outer or dermal layer, which roofs these cavities over. The dermal membrane consists of an extremely thin layer of collenchyma, invested on both sides by pavement epithelium. The thick lower layer of the cortex is differentiated into two zones which pass into each other, an innermost consisting of fibrous collenchyma, *i.e.*, collenchyma containing fusiform cells, the matrix surrounding them being finely fibrillated; and an outer consisting of cavernous collenchyma, in which branching collencytes are predominant, but which also contains fusiform cells; these, however, run more or less radially in the outer zone, converging towards the spicular columns when in their neighbourhood, while the fusiform cells and the fibrillation parallel to them in the inner zone have a tangential direction, as in the inner fibrous layer of the adult cortex. The thickness of the entire ectosome varies from 0·16 to 0·24 mm., but over the base, where the subdermal cavities are less developed, it is only about 0·06 mm. or even less. Certain very conspicuous elements, most obvious in the ectosome, but also present in the choanosome, remain to be mentioned. These are small, dark coloured, almost black, approximately spherical, granular aggregates, which in the ectosome lie separately in small vesicular cavities of the collenchyma. They are about 0·008 mm. in diameter, consist of spherical granules about 0·001 mm. in diameter, and arise from the transformation of small nucleated cells, about 0·006 mm. in diameter. They form a layer beneath the epithelium of the subdermal cavities, surrounding these on all sides; in the dermal membrane the layer is only a single cell in thickness, but beneath the floor of the subdermal cavities it may be either one or several cells thick. The layer of pigment-cells is continued beneath the epithelium of the canals which extend from the floor of the subdermal cavities through the inner layer of the cortex into the choanosome. These pigment-cells appear to represent the oval depressed cells, which were mentioned as occurring in the cortex of the adult sponge, and which are probably to be regarded as exhausted pigment-cells.

The Choanosome.—This has very much the same structure as that of the adult

sponge. The mesoderm consists of sarcenchyma, except about the spicular tracts, where it passes into collenchyma.

The Canal System.—The dermal membrane is perforated by pores which lead directly into the subdermal cavities, from these canals are continued inwards through the cortex and descend radiately into the choanosome, where they soon lose all regularity of direction, and finally communicate with the flagellated chambers, which vary from 0·0276 to 0·0395 mm. in diameter, and open into the excurrent system by narrow aphodal canals.

Spicules.—The cortex is without special oxeate spicules, but the radiating spicular fibres are well developed, and already present traces of a spiral arrangement. They are composed of all the forms of spicules which are present in the adult. The oxeas do not call for special remark, but the anatriænes present a very interesting series of forms; the simplest are terminated distally by a swollen bulb-like thickening (tylote), within which the axial fibre ends simply, or in a slight enlargement; in other cases small processes representing the axial fibres of cladi proceed from it, but end within the bulb, the cladi themselves being absent (Pl. V. fig. 15). Stages in which only one or two cladi are present, occur along with others in which all three are developed. The cladi extend at right angles to the rhabdome for a considerable part of their course, and are suddenly bent back near the ends. The protriænes are similar to those of the adult, though cases in which only two cladi are present appear to be more numerous. Microscleres which are absent in the adult do not appear in the embryo.

Spicule-Cells or Scleroblasts (Pl. II. fig. 20).—These somewhat fusiform darkly staining granular cells are very numerous and well displayed. They are about 0·01 mm. broad by 0·023 mm. long, and the contained granules, which are spherical, are about 0·002 mm. in diameter. Granules similar in size and appearance can in many cases be traced from the cell along the whole length of the spicule, showing that the spicule does not simply penetrate the scleroblast, but lies wholly immersed in it. In the case of the anatriænes the film coating the rhabdome thickens over the cladome into a mass of protoplasm, completely embedding it up to the points of the cladi.

Planula Stage (Pl. XL. fig. 5).—The preceding embryos, fully developed, but for the absence of an oscule which I could not find, are large and consistent enough to be separated from the mother sponge and sliced separately; less developed embryos are also present in the basal part of the mother sponge, but they so readily fall to pieces that they can only be sliced along with the tissue in which they occur, and as this is traversed by stout spicules, it is very difficult to obtain slices as perfect as could be wished. I have succeeded, however, in preparing serial sections of the planula of this sponge, the only other stage in its development I have met with. It may be added that ova were not observed in any part of this preparation.

The planula is egg-shaped, about 0·8 mm. long by 0·5 mm. broad where broadest. The hypoblast consists of oval masses, often polygonal by appression, about 0·065 by

0·097 mm. in length and breadth; they are aggregates of more or less spherical or polygonal, discrete granules, which are not immersed in any kind of matrix, and thus at the slightest touch fall apart; hence the want of consistency in these embryos which renders it impossible to isolate them in a whole state from the parent. The granules are of very different sizes, ranging from about 0·001 to 0·006 mm. in diameter; they are deeply stained, transparent, and under high magnification appear to consist of a homogeneous substance, in which several very minute granules are embedded. I sought in vain for a nucleus either in the polygonal aggregates, or in the granules of which they are composed. The epiblast occurs over each end of the planula as a layer of columnar flagellated cells; they are from 0·006 to 0·01 mm. long, by 0·002 to 0·004 mm. thick. The outer ends of these cells end evenly in a comparatively darkly stained margin from which the flagella proceed; the inner ends are rounded and do not end at the same level, but adapt themselves to the inequalities of the surface of the granule-aggregates. The nucleus lies in the outer half of the cell. The thickness of the columnar layer diminishes as it extends from the ends on to the sides of the planula, and appears to pass into an epithelium consisting of cells broader than high, but this is a point I could not satisfactorily determine. The cavity of the choanosome within which the embryo is contained is lined by a distinct epithelial layer.

Craniella carteri, Sollas (Pl. I. figs. 28–35).

Craniella carteri, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 182, 1886.

Sponge (Pl. I. fig. 28) subspherical, free. Oscules two or more in number. Surface irregularly conulose, the conules differ in size and proximity to each other; around the oscules they are larger than elsewhere; the skin between them is smooth. Anchoring filaments absent, as also a differentiated base. The ectosome as in the genus; the outer layer of the cortex distinguished by subdermal pigment-glands.

Spicules.—I. Megascleres. 1. *Somal oxea* (Pl. I. fig. 29), anisoactinate, fusiform, maximum diameter nearer the distal end; 2·56 by 0·0276 to 0·0345 mm.

2. *Cortical oxea* fusiform, 0·8 by 0·026 mm.

3. *Protriæne* (Pl. I. figs. 31, 32). Rhabdome regularly attenuated from the cladome to a filiform termination; cladi conical, equal; rhabdome 3·49 by 0·0138 to 0·0158 mm.; cladi 0·0868 by 0·0118 mm.

4. *Anatriæne* (Pl. I. figs. 30, 33). Rhabdome as in the protriænes; cladi not quite terminal, the rhabdome being continued far enough to give a double curvature to the distal margin of the cladome; rhabdome 6·75 by 0·016 to 0·02 mm.; cladi 0·06 mm. long.

II. Microscleres absent.

Colour.—An ochreous-white or brown tint; one specimen dotted over with brown spots.

Habitat.—Bahia.

Remarks.—Two specimens were obtained of this sponge, each measuring about 20 mm. in diameter.

The cortex (Pl. I. fig. 34) is that of a typical *Craniella*, it varies in thickness from about 1·27 to 1·75 mm.; the outer layer varies from 0·16 to 0·8 mm., the inner or fibrous layer from 0·8 to 0·9 mm. As a rule the subdermal cavities separate the outer from the inner layer, but when these are absent, as happens in some places, the two layers pass gradually into each other. The inner layer does not differ in any essential characters from that of *Craniella cranium*, the outer, however, is distinguished by the presence of a number of conspicuous, round or oval bodies, ranging from 0·09 by 0·05 to 0·48 by 0·32 mm., in section they are dotted through with coloured granules, and, as they do not stain with reagents, they stand in strong contrast to the surrounding tissue from which, at the same time, they are sharply delimited. Seen under a higher magnification (Pl. I. fig. 35) they present themselves as parenchyma-like masses of polygonal cells, each 0·015 to 0·035 mm. in diameter, with a distinct, well-marked cell-wall, like that of a vegetable cell; the most conspicuous contents are spherical, yellowish, or ochreous granules, about 0·002 mm. in diameter, several lying in each cell. The remaining contents are only with difficulty discernible; they consist of an unstained or only faintly stained finely granular substance, in which, besides the coloured granules, a spherical body 0·004 mm. in diameter, containing a spherical granule, occurs, and probably represents a nucleus with its nucleolus. The constancy and abundance of coloured granules within the cells would lead one to regard the bodies they compose as pigment-glands.

The surrounding tissue, often relatively very small in quantity, is a collenchyma, the matrix of which, however, stains evidently with hæmatoxylin. It sometimes becomes fibrous, sometimes vesicular, and occasionally contains isolated oval cells precisely similar in structure to those which compose the pigment-glands.

The larger pigment-glands are sometimes invaded by strands of the collenchyma, which penetrate into their midst.

Briefly summarising the structure of the cortex; most externally is the investing epithelium, beneath this a layer of dense collenchyma, traversed by tangential fusiform cells, and about 0·005 to 0·008 mm. in thickness; then follow the pigment-glands, with a variable quantity of associated collenchyma; and finally a thinner or thicker layer of collenchyma, covered on its lower face with epithelium, which completes the outer layer. Then follow the subdermal or intercortical cavities, and beneath these the inner layer of the cortex, consisting of a felt of tangentially arranged fusiform cells, traversed by the cortical oxeate spicules.

The choanosome does not contain any pigment-cells; its mesoderm is a sarcenchyma, except where it surrounds the larger water canals, where it becomes a collenchyma, the collencytes of which are elongated in directions radiating from the canal; numerous

fusiform cells are associated with them, similarly arranged. The branching processes of the collencytes also take other directions, both concentric and oblique. The processes of the collencytes can be traced into connection with the epithelial cells on the one hand, and the choanocytes and the cells of the sarcenchyma on the other. Collenchyma also forms the spicular tracts, the collencytes lying around the spicules. Near the cortex large stellate-cells, lying in vesicular cavities bounded by a definite wall, are frequent.

The flagellated chambers vary from 0·02 by 0·0237 to 0·0237 mm. by 0·035 mm.; the choanocytes are from 0·002 to 0·003 mm. in diameter at their base.

Craniella pulchra, n. sp.

Sponge subspherical, surface with numerous conules, bearing projecting spicules. Oscules, one or more in number, surrounded by longer conules than occur over the rest of the surface.

Spicules.—I. Megascleres. 1. *Somal oxea*, fusiform, anisoactinate, obtusely pointed at the distal end, sharply pointed and almost filiform at the proximal end, 4·6 by 0·0513 mm. in one specimen, 3·93 by 0·0513 mm. in another.

2. *Cortical oxea* fusiform, 1·2 by 0·0395 mm.

3. *Protriæne.* Rhabdome cylindrical, tapering to a filiform extremity, cladi conical; rhabdome 7·1 by 0·0225 mm. in one specimen, and 6·07 by 0·0225 mm. in another; cladi 0·125 mm. long.

4. *Anatriæne.* Rhabdome cylindrical, tapering to a filiform extremity; cladome almost conical, somewhat pointed in front; the axial fibre of the rhabdome continued into it up to its termination, *i.e.*, for a distance of 0·0158 to 0·0197 mm. past the origin of the cladi. Rhabdome 8·57 by 0·0165 mm. in one specimen, 7·678 by 0·0165 mm. in another; cladi 0·0434 by 0·0118 mm.

II. Microscleres absent.

Colour.—One specimen almost snow-white, the other cream-coloured with a tendency to brown.

Habitat.—Station 163A, off Twofold Bay, Australia, April 4, 1874; lat. 36° 59′ S., long. 150° 20′ E.; depth, 150 fathoms; bottom, green mud.

Remarks.—This sponge is very similar in most characters to *Craniella simillima*, Bwk., but is distinguished by the considerably greater size, both in length and breadth, of the oxeate spicules, and by the greater number and smaller size of the conules. There are two specimens of the species, both dredged together, but differing somewhat in general appearance. The larger, which measures 31 mm. in average diameter, has three oscules, and its conules are coarser and more rigid than those of the smaller form, which measures

21 mm. in diameter. The smaller specimen differs in other details from the larger; there is but one oscule, and the oscular conules are not so much longer than those of the general surface as they are on the larger specimen; the colour is almost snow-white, while the larger one is tinted faintly brown. These external differences are accompanied by a difference in the length but not in the thickness of the spicules, those of the smaller specimen being the shorter. It occurred to me that these differences might possibly be sexual, and thin slices from both specimens were therefore particularly examined for sexual elements; in neither, however, do they exist.

The cortex presents the typical *Craniella* structure; the outer layer is from 0·32 to 1·0 mm. thick, the inner layer 1·43 to 1·93 mm. thick, and the total thickness is from 1·75 to 2·4 mm.

The flagellated chambers measure about 0·0276 and 0·037 mm. along two diameters, the prosodal canals are short, not over 0·016 mm. long, the aphodal canals are longer; the choanocytes are about 0·0039 mm. in diameter and 0·0039 mm. long, where the flagellum is not extended; where it is, they are 0·006 mm. long, and the flagellum over 0·01 mm. long.

Craniella schmidtii, n. sp.

Sponge spherical, similar to *Craniella cranium*.

Spicules.—I. Megascleres. 1. *Somal oxea*, fusiform, the proximal end more sharply pointed than the distal, but not filiform; 1·34 by 0·03 mm. to 1·6 by 0·04 mm.

2. *Cortical oxea* fusiform, 0·414 mm. by 0·0276 mm.

3. *Protriæne*, of this there are two varieties which pass into each other; one with shorter and stouter, the other with longer and more slender cladi; in the latter the rhabdome has a diameter of 0·0118 mm., and the cladi measure from 0·142 by 0·012 mm. to 0·16 by 0·016 mm., in the former the diameter of the rhabdome is 0·0237 mm., and the cladi measure 0·127 by 0·0237 mm.

4. *Anatriæne*, a rapidly tapering rhabdome, with the cladi extending horizontally for a great part of their course before recurving. Cladi 0·075 by 0·0158 mm., chord 0·01 mm.; the axial fibre of the rhabdome extends 0·0158 mm. beyond the origin of the cladi.

II. Microsclere. 5. *Sigmaspires* numerous, 0·0197 mm. long.

Colour.—Greyish-white.

Habitat.—Station 24, off Culebra Island, West Indies, March 25, 1873; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Remarks.—This little sponge, 4·5 mm. in diameter, resembles in outward appearance and general structure *Craniella cranium*, Müll., of which I have given a full account in my

report[1] on the Rev. Dr. Norman's Norwegian Sponges. It differs in the characters of its spicules; the sigmaspires are considerably larger (as 5 : 3), and the anatriænes and protriænes differ from those of *Craniella cranium* both in form and size, the cladi of the anatriænes make a larger angle with the rhabdome, and the cladi of the protriænes are both thicker and more widely divergent. The cortex is 0·4 mm. thick. Oscar Schmidt has described two sponges, one from Iceland and the other from Florida, both as the species *Craniella cranium*. From an examination of the spicules mounted from these, and presented by Dr. Schmidt to the British Museum, I am led to doubt whether either of them is rightly assigned. The one from Iceland does not appear even to belong to the genus, and is probably a *Tetilla*. Its spicules include an oxea, 3·55 mm. long, two kinds of protriænes, one with stout equal cladi, and the other with one cladus longer than the other two; the rhabdome of this is 1·67 mm. long, the longer cladus 0·106 and the two shorter cladi 0·035 mm. long. The anatriænes are broken, so that their length cannot be ascertained; the diameter of the rhabdome is 0·011 mm., the cladi measure 0·101 by 0·009 mm., and the chord is 0·07 mm.; the sigmaspire is 0·019 mm. long.

The spicules of the specimen from Florida, also named *Craniella cranium*, are very different from those of the preceding, and probably come from a species of *Craniella* (probably *Craniella carteri*). The large oxea measures 4·26 by 0·044 mm., the sigmaspire 0·014 mm.

Craniella schmidtii (?).

There are two other small specimens (4 to 5 mm. in diameter) in the collection, which, so far as regards their spicules are almost identical with *Craniella schmidtii*. They differ, however, from this species and from the genus in the structure of the cortex, which is not differentiated into an outer and an inner layer as in *Craniella*, but consists of a single thick fibrous layer without cortical spicules. Apart from the spicules it somewhat resembles the cortex of *Craniella cranium*, as represented in Bowerbank's figures. In one of the specimens, however, it assumes over a small area the usual structure, though still remaining without cortical spicules. In the other no trace of the *Craniella* structure exists; it is, however, in such an unusual state, being crowded with large embryos, that I hesitate to give their true taxonomical value to the differences it presents.

The embryos are in different stages of development, and many of them so large, that escape, unless by perforation of the cortex, seems impossible; one embryo indeed occupies a cavity which extends into the cortex, and is only separated from the exterior by a thin membrane. Many of the embryos are also crowded with spicules, and thus it may be possible that the supply of silica obtained by the mother-sponge has been exhausted by the embryos in forming their skeleton, and thus fresh spicules to replace those

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ix. p. 149, 1882.

naturally shed from the cortex have not been forthcoming; a non-spicular cortex through which the young sponges can easily make their way to the exterior has been the result.

It is true that in a specimen of *Craniella simillima*, Bwk., also containing large embryos with fully developed spicules, the cortex retains its usual structure. The spicules of the embryos of this species, however, are not of so massive and rigid a character as those of *Craniella schmidtii* (?), so that the embryos may in this case possibly be squeezed through the canals of the parent sponge, which is, however, not a very likely supposition, and it is still possible that even in this sponge expulsion may take place through the cortex, which at a later stage may become modified for the purpose.

Development.—Three stages in the embryonal history of the sponge are represented. In the earliest, the embryo is a solid, more or less oval body, about 0·64 to 0·7 mm. long, by 0·4 mm. broad. It appears to consist entirely of rounded or polygonal cells, from 0·025 to 0·035 mm. in diameter; these cells are in turn composed of granular spherules, from 0·002 to 0·004 mm. in diameter; in their midst is one larger than the rest, and somewhat more deeply stained, varying from 0·006 to 0·012 mm. in diameter: it must, I suppose, be regarded as the nucleus, though very different in appearance from ordinary nuclei. On the exterior of the embryo is a thin layer of structureless or finely granular stained material, which extends inwards between the cells, filling the interstices left by them. This material is similar in character and distribution to the structureless blastema which I have described as investing the blastomeres of *Oscarella lobularis*, O. Sch.

The existence of an outer layer of columnar cells could not be demonstrated in embryos at this stage; though traces of such a layer appear in those of the succeeding stage. The subdivision of the large granular cells of the embryo appears to proceed very irregularly; in one embryo, the other cells remaining unchanged, one in the centre has disappeared, its place being taken by a multitude of small (0·008 to 0·01 mm. in diameter) more or less polygonal, finely granular, not deeply stained cells, in which a comparatively large spherical, vesicular nucleus, 0·004 to 0·006 mm. in diameter, with a small spherical deeply stained nucleolus, 0·002 mm. in diameter, can be distinguished.

In embryos of the next stage a structureless gelatinous matrix makes its appearance between the cells, many of which have lost their individuality and appear to be resolved into a crowd of granules; others remain unchanged and are sharply defined against the gelatinous matrix. Numerous finer fibrils traverse the matrix and can be traced into connection with isolated granules and minute fusiform and polygonal cells. Traces of a columnar epithelium are now observable at the poles of the embryo, and spicules make their first appearance. These earliest spicules are oxéas; they are of almost hair-like fineness, and are arranged more or less radiately, their distal ends pointing at right angles to the surface of the embryo, their proximal ends lying tangentially about the centre.

In the third and last stage the large granular cells have disappeared, and their conversion into collenchyma, suggested by the changes commencing in the preceding stage, is complete. The ectosome is differentiated from the choanosome, the latter consists of collenchyma, which in addition to the ordinary collencytes, includes numerous oval cells, 0·008 to 0·01 mm. in diameter, composed of spherical granules, 0·002 mm. in diameter. Its passage into the ectosome is marked by the appearance of tangentially arranged fusiform cells in the collenchyma, which is finely fibrillated, parallel to the length of these cells where it surrounds them. Further outwards, forming the floor of the subdermal cavities, the gelatinous basis of the collenchyma almost entirely disappears, and granular, deeply stained, fusiform cells, tangentially arranged, with overlapping ends, form a layer two or three cells deep, and about 0·02 mm. thick.

Canal System.—The subdermal cavities extend as canals into the choanosome and end in flagellated chambers, 0·02 by 0·03 mm. in length and breadth; so similar both in size and form are these with their choanocytal lining to the oval granular cells associated with them, that one can hardly help the suggestion that the latter have been produced by the transformation of the granules of the granule cells into choanocytes.

Spicules.—All the forms of spicule present in the adult, except sigmaspires, are found in the embryo of the last described stage. The absence of microscleres is remarkable, since triænes are present, while we have every reason to believe that phylogenetically the sigmaspire preceded the triæne in development.

Abnormal forms appear to be more common in the young than the adult state; several instances of ana- and pro-triænes, with one or more bifurcated cladi, were observed.

The protriænes gave the following measurements:—Rhabdome 0·4 by 0·0197 mm., cladi 0·07 by 0·016 mm.

Genital Elements.—In addition to embryos, sperm-balls but not ova are present in the sponge; they lie in vesicles lined by an epithelium; the diameter of the head of a spermatozoon measures about 0·002 mm.; a sperm-ball measured 0·063 by 0·028 mm., and the cavity containing it 0·075 by 0·0316 mm.

The spicules of the specimen containing embryos have the following dimensions:—(1) *Somal oxea* fusiform, 1·33 by 0·021 to 1·75 by 0·0316 mm.; (2) *cortical oxea* absent; (3) *protriæne*, rhabdome 1·27 and over by 0·0276 mm., cladi 0·119 by 0·0197 mm.; (4) *anatriæne*, rhabdome 0·024 mm. in diameter, cladi 0·103 by 0·021 mm., chord 0·16 mm.; (5) *sigmaspire*, 0·0197 mm. long.

In the specimen without embryos the measurements are:—(1) *Oxea*, fusiform, 2·23 mm. long; (2) *protriæne*, rhabdome 1·27 to over 1·6 by 0·021 mm., immediately below the cladome increasing to 0·0237 mm., and then diminishing in diameter; cladi 0·16 by 0·019 mm.; (3) *sigmaspire*, 0·019 mm. long.

Supplemental Account of all other known Species of Tetillidæ not in the Challenger Collection.

Tetilla antarctica (Carter).

Tethya antarctica, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. ix. p. 412, pl. xx., 1872; *non* Carter, *Tethya antarctica*, Phil. Trans., vol. clxviii. p. 287, 1879.

Sponge globular; oscules large, several; pores in sieves generally distributed; surface papillose with projecting spicules.

Spicules.—I. Megascleres. 1. *Oxea*, 1·25 mm. long. 2. *Protriæne*. 3. *Somal anatriæne*, with hastately-shaped cladome. 4. *Radical anatriæne*, with a grapnel-like cladome; rhabdome 37·5 mm. long.

II. Microscleres absent.

Habitat.—Antarctic Ocean; lat. 74° 30′ and 77° 30′ S., long. 175° 0′ W.; depth, 206 to 300 fathoms.

Remarks.—Carter has referred to this species a sponge obtained from 20 fathoms in Royal Sound, Kerguelen, distant about 120° of longitude and more than 20° of latitude from the locality which furnished the type. Beyond stating that the oxeate spicules of the sponge from Kerguelen are larger than those of the type, Carter gives us very little information about it. One of the characters of *Tetilla antarctica*, however, is the absence of sigmaspires, and upon this Carter justly lays great stress, not only mentioning it in describing the species, but subsequently referring to it in the course of general remarks on the Tetillidæ,[1] and elsewhere. On examining preparations of the sponge from Kerguelen identified with *Tetilla antarctica*, I find sigmaspires abundantly present; this alone is sufficient to show that the identification is erroneous. Comparing its spicules, however, with those of *Tetilla grandis* in the Challenger collection, I find so marked a correspondence that I can scarcely doubt the identity of the second sponge referred to by Carter with this species.

Tetilla arabica (Carter).

Tethea arabica, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. iv. p. 3, pl. i. figs. 1–13, pl. ii. figs. 19, 20, 1869.

Sponge spherical and free, or hemispherical and fixed; surface hispid, irregularly reticulated with ridges; pores in the depressions; oscules several large, on conical eminences. Size about 75 mm. in diameter.

Spicules.—I. Megascleres. 1. *Oxea*, 3·5 by 0·035 mm. 2. *Protriæne*, rhabdome 6·4 by 0·014 mm.; cladi 0·084 mm. long. 3. *Anatriæne*, rhabdome 4·5 by 0·01 mm.; cladi 0·084 mm. long.

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xi. p. 366.

II. Microscleres. 4. *Sigmaspire*, 0·0125 mm. long. 5. *Spherule*, 0·0042 mm. in diameter.

Colour.—Grey.

Habitat.—South-east coast of Arabia.

Remarks.—Carter's description leaves little doubt as to the genus to which this sponge must be assigned, since he speaks of the cortex as "loose and ill-defined, with tufts of spicules matted together with dermal sarcode." There are but a few dried fragments of the sponge in the British Museum collection, and so far as the structure of the ectosome could be made out in these, it appeared to be that of *Tetilla*.

Tetilla (?) *australiensis* (Carter).

Tethya cranium, var. *australiensis*, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xvii. p. 127, 1886.

Sponge ellipsoidal, sessile (?), surface finely hispid; oscules numerous, small; pores generally distributed.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, finely pointed, 5·7 by 0·038 mm. 2. *Protriæne* nearly the same length as the oxea; cladi 0·135 mm. long.

II. Microscleres. 3. *Microxea*, minutely spined, 0·21 mm. long. 4. *Sigmaspire*, 0·017 mm. long.

Colour.—Yellow. Size 112 mm. high, 65 mm. wide, and 37 mm. broad.

Habitat.—Port Phillip Heads, South Australia; depth, 20 fathoms.

Remarks.—This species is distinguished not only by the oxeate microscleres but also by the large size of the sigmaspire. The oxeate microscleres are almost unique among the Tetillidæ, *Tetilla merguiensis* being the only other species possessing them, and in it they are nothing like so abundant as in the present species.

Tetilla casula (Carter).

Tethya casula, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. viii. p. 99, pl. iv. figs. 1–9, 1871.

Sponge, see Carter's description (*loc. cit.*), distinguished by its remarkable basal fringe of spicules.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 5·0 by 0·045 mm. 2. *Protriæne*, rhabdome 10·42 by 0·013 mm., cladome distinguished by its short cladi, 0·039 mm. long, chord 0·026 mm. 3. *Trichodal protriæne*, marginal to the pore-areas, 0·416 mm. long. 4. *Anatriæne* absent.

II. Microsclere. 5. *Sigmaspire*, 0·014 mm. long.

Habitat.—Port Elizabeth, Natal, South Africa (Carter).

Remarks.—Although the minute characters of the cortex are indeterminable (the specimen is a dry one), there can be little doubt that it belongs to the *Tetilla* type; the presence of trichodal triænes is strongly in favour of this determination.

The spreading circular fringe of basal spicules reminds one of *Trichostemma hemisphericum*, Sars, it differs from the fringe of this species, however, in several details, chiefly in being denser and composed of larger spicules, which again are triænes and not styles.

Tetilla dactyloidea (Carter.)

Tethya dactyloidea, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. iii. p. 15, 1869; vol. ix. p. 82, pl. x. figs. 1–5, 1872; and ser. 5, vol. xi. p. 365, 1883. *Non* Ridley, Voyage of the "Alert," p. 625, 1884.

Sponge, a highly prolate ellipsoid; with a leash of anchoring spicules proceeding from the base; a single circular oscule at the apex; pores generally distributed. Surface pilose.

Spicules.—I. Megascleres. 1. *Somal oxea*, fusiform, exceedingly sharply pointed, 1·35 by 0·006 mm. 2. *Somal protriæne*, rhabdome 1·43 by 0·004 mm.; cladi 0·026 mm. long; chord 0·013 mm., or cladi of different lengths, the longest 0·04 mm. 3. *Radical anatriæne*, rhabdome 12·0 by 0·004 mm., cladi 0·032 mm. long, chord 0·0355 mm.

II. Microsclere. 4. *Sigmaspire*, 0·008 mm. long.

The oxeas are arranged partly in fibres and brushes, partly irregularly scattered. Except on approaching the ectosome the fibres are arranged longitudinally, but near the ectosome short brushes of spicules, directed at right angles to the surface, radiate outwards; the longitudinal fibres are crossed by the irregularly scattered spicules, and as they descend they curve outwards and enter the ectosomal brushes, to the formation of which they contribute; near the base, however, they appear to converge, and anatriænes making their appearance, the fibres issue from the sponge as the leash of anchoring filaments. The cladomes of the anatriænes form a series of successive stages of growth within the sponge, evidently growing forwards to replace those of the protruding filaments as these become effete.

Colour.—Brownish-grey.

Habitat.—South-east coast of Arabia; Mergui Archipelago; Burmah.

Remarks.—I owe to Mr. Carter's generosity a perfect example of this sponge from Mergui. It is well enough preserved in spirit to admit of examination in thin slices; the foregoing measurements are based upon it. Whether it is altogether identical with the type of the species found off the south-east of Arabia I do not feel quite certain. Carter's drawing representing the whole sponge suggests the existence of several important

differences. The hispidating spicules are represented as all directed downwards, and the base of anchoring fibres are much larger in proportion to the sponge, and apparently denser than in my specimen. Measurements obtained from Carter's description and illustrations of the spicules of the type exceed those obtained from the Mergui specimen, which is characterised by the comparative smallness of its spicules; though small they are remarkably numerous, as if in compensation, and both by their abundance and smallness give quite a distinctive facies to the sponge. The ectosome is thin; the choanosome is crowded with flagellated chambers, lying so close together as to reduce to a minimum the mesoderm, they measure about 0·04 by 0·032 mm.; the choanocytes are free (*i.e.*, not confluent by their collars), with long flagella. Although my observations were not altogether satisfactory, I came to the conclusion that the chambers are eurypylous, but the common canal into which they open is so small in most cases, that the nature of the communication is generally somewhat obscure. About the oscule the mesoderm is developed to the exclusion of flagellated chambers, it there forms a tissue consisting of oval, granular, not very deeply stained cells, set near together in a matrix which stains more deeply than the cells themselves.

Tetilla euplocamus, O. Schmidt.

Tetilla euplocamus, O. Schmidt, Spong. Algiers, p. 40, pl. v. fig. 10, 1868; Atlant. Spong. Gebiet., p. 66, 1870.
„ „ (?) E. Selenka, Zeitschr. f. wiss. Zool., Bd. xxxiii. p. 469, 1880.

Sponge small, pear-shaped; surface pilose; rootlets formed of spirally twisted anchors.

Spicules.—I. Megascleres. *Oxea*, fusiform, 2·3 by 0·22 mm.; *trichodal protriænes* (and *anatriænes*?).

II. Microscleres (?).

Habitat.—Desterro, South Atlantic (O. Schmidt). Western part of the Bay of Rio de Janeiro; depth, exposed at lowest spring-tides; bottom, sandy mud (Selenka).

Remarks.—No one from Schmidt's meagre description of this species could hope to identify it, unless by means of the spiral twist of the anchoring filaments, and this, very possibly, is not characteristic. A slide of mounted spicules, presented by Schmidt to the British Museum, showed oxeas of *Tetilla*-like form, and trichodal triænes, but no anatriænes nor sigmaspires. Selenka, with great probability, assigns a small *Tetilla* which he found at Rio to this species; it is of an olive-green to yellowish-brown colour; and is found at lowest ebb-tide, with the roots completely immersed in the sandy mud of the sea-floor, and the body projecting above. *Tetilla euplocamus* is most readily distinguished from *Tetilla leptoderma* (*vide* p. 3) by the smaller size of its oxeate spicules, which are only half the length and breadth of those in the latter species.

Tetilla gravata, Hyatt.

Tetilla gravata, Hyatt, Johnson's New Universal Cyclopædia, vol. vi. p. 1668, fig. 1, 1878.

Sponge rounded, cylindrical, one or more large oscules at the summit; surface finely but densely hispid; size, 100 mm. in height by 100 to 150 mm. in diameter.

Spicules.—I. Megascleres. 1. *Oxea* fusiform, distal actine shorter and more abruptly pointed than the proximal; 2·0 by 0·016 mm. 2. *Protriæne*, rhabdome 3·5 by 0·01 mm.; cladi 0·035 mm. long. 3. *Trichodal protriænes* marginal to the pore-areas. 4. *Anatriæne*, rhabdome 3·5 by 0·006 mm.; cladi 0·04 mm. long, chord 0·04 mm.

II. Microsclere. 5. *Sigmaspire*, 0·013 mm. long.

Habitat.—Buzzard's Bay, Massachusetts, North America.

Remarks.—This sponge is distinguished by its disproportionately small spicules; the cladomes of the triænes are also much smaller than usual. There is a fine specimen in the British Museum Collection; this I have examined, but have not seen Professor Hyatt's description; for the reference to it I am indebted to the kindness of Professor A. C. Verrill.

Tetilla geniculata, Marenzeller.

Tetilla geniculata, E. von Marenzeller, Poriferen, &c., von Jan Mayen, 1886, p. 5, pl. i. fig. 4 (published in Die Internationale Polarforschung, 1882–83, Die oesterreichische Polarstation Jan Mayen, Bd. iii.).

Sponge; a fragment, bearing a single oscule, 4·0 mm. in diameter on its intact upper surface.

Spicules.—I. Megascleres. 1. *Oxea*, 5·0 by 0·03 mm. 2. *Trichodal protriæne.* 3. *Protriæne* with cladi of unequal length. 4. *Anatriæne*, rhabdome 10·0 mm. and over in length.

II. Microsclere. 5. *Sigmaspire* with a central spherical thickening of the spire (centrotylote) 0·013 mm. long.

Habitat.—Jan Mayen, 191 to 216 fathoms.

Remarks.—This species, which is fully described and illustrated by its author, is distinguished from all others of the genus by the characteristic centrotylote sigmaspires.

Tetilla japonica, Lampe.

Tetilla japonica, W. Lampe, Eine neue Tetractinelliden form mit radiärem Bau.[1]

Sponge ellipsoidal; bearing a single circular oscule at the summit; produced into rooting filaments at the base; surface hispid, with projecting spicules, raised into

[1] Inaugural Dissertation, 1886, pp. 1–18, pl. i. Reprinted from the *Archiv f. Naturgesch.*

conules, which are united by ridges, circumscribing shallow depressions, in each of which is situated a large pore. Size 24 by 12 mm.

Skeleton.—I. Megascleres. 1. *Oxea*, 4 mm. and over by 0·008 mm. 2. *Protriænes* of two kinds; one with three equal cladi, rhabdome 0·001 mm. in diameter, cladi 0·004 mm. long; the other with two shorter cladi and one longer, rhabdome 0·003 mm, in diameter, longer cladus 0·04 mm., shorter cladi 0·02 mm. long. 3. *Anatriæne*, rhabdome 0·005 mm. in diameter; cladi 0·025 by 0·005 mm.

II. Microscleres. 4. *Sigmaspire*, spined on the outer side of the spire, 0·017 mm. long. 5. *Spheraster*, consisting of rosette-like groups of fifteen to twenty radiately arranged fusiform actinees.

Canal System.—Flagellated chambers, 0·03 by 0·02 mm.; main excurrent canals six in number, radiately arranged.

Habitat.—Japan; depth ?

Remarks.—This sponge is fully described and illustrated by the author; it is distinguished by its small spined sigmaspires, and the regular arrangement of the six main excurrent canals. The spherasters are unique, and one feels a certain suspicion that they may not belong to the sponge. Lampe's description would lead one to infer that the canal system is aphodal; this is not the case in any *Tetilla* I have examined, nor in any sponge with a collenchymatous mesoderm, such as this is stated to possess; so that there may be some error in this observation. Both ova and spermatozoa were observed.

Tetilla polyura, O. Schmidt.

Tetilla polyura, O. Schmidt, Spong. Atlant. Gebiet., p. 66, pl. vi. fig. 8, 1870.
" " (?) Vosmaer, Spong. "Willem Barents" Exped., p. 9, pl. i. figs. 1–3; pl. v. figs. 3–7, 1885.

Habitat.—Iceland, 85 fathoms (O. Schmidt). Arctic Ocean; lat. 77° 7′ N., long. 49° 37′ E.; lat. 75° 20′ N., long. 46° 40′ E.; lat. 72° 36′ N., long. 24° 57′ E.; from 140 to 170 fathoms (Vosmaer).

Remarks.—The possibility of *Tetilla sandalina*, n. sp., being identical with this species has been already alluded to (p. 3). Schmidt's description is inadequate, and the mounted spicules of Schmidt's sponge in the British Museum are too fragmentary for satisfactory comparison. The protriæne presents two shorter cladi about 0·07 mm., and a third longer cladus about 0·18 mm. long. The sigmaspires measure about 0·02 mm. in length. Vosmaer's illustrations of the sponge, which he thinks may belong to Schmidt's species, are excellent; unfortunately he gives no measurements of spicules.

Tetilla radiata, Selenka.

Tetilla radiata, E. Selenka, Ueb. einen Kiesel-Schwamm v. achtstrahligem Bau, &c., Zeitschr. f. wiss. Zool., Bd. xxxiii. p. 467, pl. xxvii., 1880.

Habitat.—Rio de Janeiro; depth, 3 fathoms; bottom, blue-black mud.

Remarks.—Selenka distinguishes this sponge from that which he identifies with *Tetilla cupolocamus*, O. Schmidt, by its smaller size, rose-red colour, and thinner oxeate spicules, which are from 0·008 to 0·01 mm. in diameter. Its chief excurrent canals show a tendency to a radiate arrangement in multiples of four (4×2); but though eight thus usually occur, seven and nine have also been observed. The sexes are distinct, but multiplication also takes place asexually by budding.

Tetilla ridleyi, n. n.

Tetilla dactyloidea, Ridley, Voyage of the "Alert," p. 625, 1884.

Sponge (?), an imperfect specimen, 40 mm. in diameter.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 2·5 by 0·026 mm. 2. *Protriæne*, rhabdome 0·004 mm. in diameter; cladi 0·071 mm. long. 3. *Anatriæne*, rhabdome 0·004 mm. in diameter; cladi 0·045 mm. long, chord 0·06 mm.

II. Microsclere. 4. *Sigmaspire*, 0·011 mm. long, rarely becoming toxospiral, then 0·016 mm. long.

Habitat.—Glorioso Islands, low water (Ridley).

Remarks.—This sponge is very different to that from Mergui which Carter has named *Tetilla dactyloidea*, as I judge from a comparison of specimens. It would appear also, from Carter's description, to differ considerably from the sponge to which Carter first applied the name "*dactyloidea*."

The ectosome is not furnished with a special skeleton, but attains a considerable thickness, about 0·7 mm.; it consists of soft fibrous tissue, charged with what appear to be pigment-cells. The surface is thickly hispidated by spicules, of which the outer ends are broken off; they appear, however, to be oxeas. Triænes appear to be rare, those from which the measurements were taken were situated wholly within the sponge, the cladome lying just below the outer epithelium.

Tetilla robusta (Carter).

Tethya cranium, var. *robusta*, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xi. p. 367, 1883.

Sponge more or less spherical; ectosome perforated by apertures about 10 mm. in diameter, which lead into large irregular roundish cavities, lined by a smooth membrane.

Surface hispidated by projecting spicules, chiefly oxeas, which are frequently borne at the ends of band-like processes; these and the numerous apertures give the sponge a characteristic ragged appearance.

Spicules.—I. Megascleres. 1. *Oxea*, isoactinate, 3·34 by 0·045 mm. 2. *Protriæne*, rhabdome 4·0 mm. (and over?) by 0·008 mm.; cladi 0·13 mm. long; chord 0·048 mm. 3. *Anatriæne*, rhabdome 4·0 mm. (and over?) by 0·004 mm.; cladi 0·045 mm. long; chord 0·058 mm.

II. Microsclere. 4. *Sigmaspire*, 0·034 mm. long.

Habitat.—King's Island, Mergui Archipelago, coast of Burmah.

Remarks.—The large cavities beneath the ectosome may be of the nature of vestibules, as indeed Dr. von Lendenfeld when I called his attention to them appeared to think they were; and it is possible that they may prove of sufficient importance for generic distinction of the species.

The sigmaspires are much longer than usual, and the cladi of the anatriænes much shorter.

Tetilla (?) *stipitata* (Carter).

Tethya stipitata, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xviii. p. 460, 1886.

Sponge fig-shaped, stipitate; stem hard, dense, cylindrical, expanding into the body of the sponge above, and into a root-like mass below, which is charged with coarse sand. Oscules several, the largest on the summit.

Spicules.—I. Megascleres. 1. *Oxea* isoactinate, 3·5 by 0·032 mm. 2. *Radical anatriæne;* cladi short and stout, only slightly reflexed backwards. 3. *Radical amphitriæne*, very variable in form and size; rhabdome 0·32 by 0·032 mm., and 0·56 by 0·019 mm.; cladi simple, 0·15 mm. in length.

II. Microscleres. 4. *Sigmaspire*, 0·024 mm. in length. 5. *Radical microstrongyle*, variously curved, from a parabola to an almost straight line, minutely spined, 0·059 mm. long. Protriænes and somal anatriænes absent.

Colour.—Reddish-purple above, white below.

Habitat.—Port Phillip Heads, South Australia.

Remarks.—For the opportunity of examining preparations of this sponge I am indebted to the kindness of Mr. Carter, who has not only sent me mounted spicules, but a coloured illustration of the whole sponge. It is one of the most remarkable of the Tetillids, distinguished by a conjunction of unique characters. The rigid stem is peculiar to it, so also are the amphitriænes which occur only in the stem, and the curved microstrongyles, which are also chiefly confined to the stem. The sigmaspires are

larger than usual and appear to pass into the microstrongyles, and as these pass from a highly curved to an almost straight form, we appear to have here another case of the development of a rhabdus from a spire.

The specimen of the sponge is unfortunately a dried one, and in the absence of any exact knowledge of its general anatomy, it is impossible to determine its true place among the Tetillid genera. The cortex appears to be that of *Tetilla*, but the characters of its spicules are so peculiar (probably in adaptation to the stalked manner of attachment) that one would not be surprised if, on further examination, it were found to be the type of a new genus. The amphitriænes sometimes are reduced to simple triænes, the end of the rhabdome, from which a triæne has disappeared, being then strongylate. I was not able to satisfy myself of the independent existence of the anatriæne, it appeared to me possible that it might be a form of the amphitriæne.

Craniella abyssorum (Carter).

Tethya cranium, var. *abyssorum*, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 405, pl. xvi. fig. 49, 1875.
„ „ „ „ Norman, Bowerbank, Mon. Brit. Spong., vol. iv. p. 39, 1879.

Sponge similar to *Craniella cranium*.

Spicules.—I. Megascleres. 1. *Somal oxea*, 4·3 by 0·045 mm. 2. *Cortical oxea*, 0·7 by 0·045 mm. 3. *Protriæne*, rhabdome 4·3 by 0·022 mm.; cladi 0·22 mm. long; chord 0·11 mm. 4. *Anatriæne*, rhabdome 6·5 by 0·02 mm.; cladi 0·116 mm. long; chord 0·16 mm.

II. Microsclere. 5. *Sigmaspire*, 0·02 mm. long.

Habitat.—Deep-sea, between the north of Scotland and the Færöe Isles (Carter).

Remarks.—The sigmaspire is much larger than in *Craniella cranium*, and frequently forms a little more than one revolution of a spiral; in addition the cladome of the anatriæne is characterised by longer, more slender, and more divergent cladi than in the corresponding spicule of *Craniella cranium;* the cortical oxea also is smaller. Hencè I prefer, while admitting that it is very much a matter of taste, to make Carter's variety a distinct species.

Craniella atropurpurea (Carter).

Tethya atropurpurea, Carter, Ann. and Mag. Nat. Hist., vol. vi. p. 176, pl. xiii. figs. 1–10, 1870.

Sponge spherical, compressed, free; surface raised into conules.

Spicules.—I. Megascleres. 1. *Somal oxea*, 3·57 by 0·0556 mm. 2. *Cortical oxea*, 1·25 by 0·0556 mm. 3. *Protriæne*, 5·0 by 0·014 mm. 4. *Anatriæne*, rhabdome 5·0 by 0·014 mm.

II. Microsclere. 5. *Sigmaspire*, 0·0625 mm. long. The sigmaspires are spined on the outer side and at their extremities; they are also three to four times as large as those of most Tetillidæ.

Colour.—Purplish-black.

Habitat.—Unknown.

Remarks.—The cortex of this remarkable sponge is that of a genuine *Craniella*, it measures about 1·2 mm. in total thickness, the outer layers, with the usual characters of *Craniella*, being about 0·9 mm., and the inner layer with widely extending subdermal cavities about 0·3 mm. across. Carter represents the natural surface of a half of the sponge, which in the entire state was approximately spherical; apparently it had been bisected, one half sent to Carter to describe, and the other retained in the British Museum collection; the two halves are now placed together with a common label.

The gigantic spined sigmaspires are quite sufficient to characterise the species.

Craniella cranium, auctt.

Alcyonium cranium, Müll., Zool. Dan., pl. 85, fig. 1, 1789.
Tethya cranium, Lmk., Mém. d. Mus., vol. i. p. 71, 1815.
Alcyonium cranium, Lmx., Hist. d. Polypes, p. 347, 1816.
Spongia pilosa, Mont., Mem. Wern. Soc., vol. ii. p. 119, pl. xiii. figs. 1–3, 1818.
Tethya cranium, Flem., Brit. Animals, p. 519, 1828.
„ „ Blainv., Mém. d'Act., p. 544, 1834.
Tethea cranium, Johnst., Brit. Spong., p. 83, pl. i. figs. 1–8, 1842.
„ „ Bwk., Mon. Brit. Spong., vol. i. p. 182, pl. xxxi. fig. 362, 1864.
„ „ Bwk., Mon. Brit. Spong., vol. ii. p. 83, 1866.
Tethya cranium, O. Sch., Spong. Adriat. Meeres, Suppl. ii., pl. i. fig. 14, 1866.
„ „ Gray, Proc. Zool. Soc. Lond., p. 543, 1867.
„ „ Carter, Ann. and Mag. Nat. Hist., vol. viii. p. 104, 1870.
„ „ Carter, *Op. cit.*, vol. ix. p. 419, pl. xxii. fig. 9, 1872.
„ *unca*, Bwk., Proc. Zool. Soc. Lond., p. 118, pl. v., 1872.
„ *cranium*, Bwk., Mon. Brit. Spong., vol. iii. p. 315, pls. xiv., lxxxix., 1874.
Tetilla cranium, Müll., and *Craniella cranium*, Soll., Ann. and Mag. Nat. Hist., vol. ix. p. 149, pl. vii., and p. 327, 1882.
Tethya cranium, var. *typica*, Norman, Bwk., Mon. Brit. Spong., vol. iv. p. 39, 1882.
Tetilla cranium, Hansen, Norske Nord. Exped., Spongiadæ, p. 18, pl. v. figs. 3, 4; pl. vii. fig. 16, 1885.
Craniella mülleri, Vosmaer, Sponges of the "Willem Barents" Expedition, p. 6, pl. ii. figs. 9–15; pl. v. figs. 1, 2, 1886.
Non Tetilla cranium, O. Sch., Spong. Atlant. Gebiet., p. 63, 1870.

Spicules.—I. Megascleres. 1. *Somal oxea*, anisoactinate, distal actine thicker than the proximal, which is attenuated to an almost filiform termination, 2·1 by 0·05 mm. (Bwk.), 2·18 by 0·027 mm. (Soll. N)., 4·28 by 0·05 mm. (Soll. C.).

2. *Cortical oxea*, 0·83 by 0·038 (Bwk.), 0·9 by 0·032 mm. (Soll. C.).

3. *Protriæne*, rhabdome 3·2 by 0·018 mm.; cladi 0·17 mm. long (Bwk.); rhabdome 5·4 by 0·013 mm.; cladi 0·15 mm. long, chord 0·084 mm. (Soll. C.).

4. *Anatriæne*, rhabdome 2·1 by 0·011 mm. (Bwk.), rhabdome 3·9 by 0·012 mm.; cladome subterminal, cladal centre 0·012 from the distal termination of the axis of the rhabdome cladi; 0·05 mm. long, chord 0·063 mm. (Soll. N.); rhabdome 11·4 by 0·02 mm.; cladome terminal, cladi 0·084 mm. long, chord 0·095 mm. (Soll. C.).

II. Microsclere. 5. *Sigmaspire*, 0·0095 mm. long (Bwk.), 0·012 mm. long (Soll. N.), 0·012 mm. long (Soll. C.).

Habitat.—The Island of Arran; Galway, Ireland (Bwk.); Shetland Isles, deep water (Bwk.); The Minch, deep water (Norman); Kors Fjord, Norway, 180 to 300 fathoms (Norman, Sollas); lat. 61° 0′ N., long. 4° 49′ E., 200 fathoms, bottom, ooze and clay, temperature 6°·6 C.; and lat. 72° 53′ N., long. 21° 51′ E., 223 fathoms, bottom, clay, temperature 1°·5 C. (Hansen); near the last mentioned locality, in 140 to 165 fathoms (Vosmaer); deep sea, between Færöe Isles and North of Scotland (Carter).

Remarks.—The initials (Bwk.) indicate measurements taken from Bowerbank's descriptions; (Soll. N.) measurements by Sollas of specimens dredged by Norman; (Soll. C.) measurements by Sollas of specimens described by Carter. None of these sets of measurements are accordant, except in the case of the cortical oxeas and the sigmaspires. The discrepancy is probably due to the spicules measured having been obtained from sponges of different size, thus Carter's are many times larger than Norman's specimens. As to the size of the specimens from which Bowerbank obtained his spicules we have no knowledge; it would be worth while to re-examine some of the three hundred specimens obtained by Bowerbank, with a view to determining the size of their spicules anew. Mr. Carter has kindly sent me mounted spicules of the specimen of *Craniella cranium* figured by Bowerbank as seated in *Phakellia ventilabrum;* these are of the largest size given in the preceding measurements. The spicules of *Tethya unca*, Bowerbank, have the same size as the larger ones of the foregoing descriptions, and it would seem just possible that the fact of their being about twice as long as those of *Tethya cranium*, as given in Bowerbank's published measurements, led him to distinguish between the supposed two species; on the other hand, he expressly states that the distinction rests on the smaller size of the sigmaspire in *Tethya unca*, and as, after an examination of specimens in the British Museum, I do not find even this difference to exist, I see no alternative but to include *Tethya unca* as a synonym of *Tethya cranium*.

Norman describes as *Tethya cranium*, var. *acufera*, specimens in which one-third of the rhabdus spicules are strongyloxeas. *Craniella zetlandica*, *Craniella abyssorum* and *Craniella infrequens* he also regards as varieties of *Craniella cranium*. Vosmaer's proposal to re-name this species appears superfluous. The fact that Müller's sponge, which appears to have been *Craniella cranium*, was erroneously identified as *Alcyonium cranium*, in

nowise disqualifies the specific designation from being used with a new generic name, and since, for the last fifty years, it has been continuously employed by a succession of authors to designate the same sponge, it is likely to continue to be so employed, unless more cogent objections than those alleged by Vosmaer are forthcoming.

Good accounts of the general characters are given by Johnson and Bowerbank; the histology is described in my paper on the species (*loc. cit.*). Vosmaer found in his specimens "a stronger developed dermal mesodermic layer with smaller subdermal cavities" than I figured in mine, and conjectures that this may be due to a "different state of contraction." The fact I do not doubt, the explanation I do not understand, but this is of no consequence as Vosmaer's description explains itself. There is, as he truly says, relatively more mesodermal tissue in the outer part of the cortex in his specimens than in mine, and consequently the subdermal cavities are smaller; the relative abundance of mesoderm is connected with the growth of the sponge, in one sponge there may be more, in another less (indeed, in the same individual the cortex may vary from the structure shown in Vosmaer's figure to that represented in mine), and in a young sponge there is less than in a fully grown one; evidently Vosmaer's specimens were more fully grown than mine, which are not more than 10 mm. in diameter. Vosmaer complains of my illustrations of this species as being "diagrammatic," I take the opportunity of explaining that there are no grounds for this charge; my drawings are accurate tracings by "camera lucida," mere outlines, and very inartistic, no doubt, but absolutely faithful, and, after all, on comparing them with Vosmaer's more finished figures, I fail to see that they convey less real information (*loc. cit.*, pl. ii. fig. 10).

O. Schmidt fell into great confusion with respect to this sponge. One almost doubts whether he could ever have seen it, or surely he would not have referred it to *Tetilla*. His genus *Craniella* is evidently, however, founded on the characters of this species. The two slides of mounted spicules presented by Schmidt to the British Museum as examples of *Tethya cranium* are evidently from two quite different sponges, one from Iceland may be *Tetilla polyura*, the other from Florida some species (not *cranium*) of *Craniella*.

Craniella infrequens (Carter).

Tethya cranium, var. *infrequens*, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 405, pl. xvi. fig. 48, 1876.
" " " " Norman, Bwk., Mon. Brit. Spong., vol. iv. p. 43, 1882.
" " " " Hansen, Norske Nord. Exped., Spongiadæ, p. 18, pl. v. fig. 5, and pl. vii. figs. 17, 18, 1885.

Sponge similar to *Craniella cranium*.

Spicules.—I. Megascleres. 1. *Somal oxea*. 2. *Cortical oxea*, 0·58 by 0·032 mm. 3. *Protriæne*, rhabdome 0·032 mm. in diameter; cladi 0·14 by 0·026 mm., chord 0·16 mm. 4. *Anatriæne*, cladi 0·16 by 0·02 mm. chord 0·22 mm.

II. Microscleres absent.

Habitat.—Station 57, "Porcupine" Expedition between Scotland and the Færöe Isles, 632 fathoms (Carter). Station 286, Norwegian Expedition; lat. 72° 57′ N., long. 14° 32′ E., 447 fathoms; bottom temperature, 0°·8 C.; bottom, clay (Hansen).

Remarks.—This is an excellent species, differing from *Craniella cranium*, not only in the absence of sigmaspires, but more particularly in the singular and striking character of the protriæne, which has been well described and illustrated by Carter. The cladome of the anatriæne is also very different in form from that in *Craniella cranium*, its cladi being much longer and more divergent. Carter's suggestion that the form of the protriæne is the result of disease cannot be entertained.

Craniella insidiosa, O. Schmidt.

Craniella insidiosa, O. Sch., Spong. Atlant. Gebiet., p. 67, pl. vi. fig. 11, 1870.

Habitat.—Florida; depth, 17 fathoms.

Remarks.—This species is insufficiently characterised. I have not been able to obtain specimens for examination.

Craniella lens, O. Schmidt.

Craniella lens, O. Sch, Spong. Atlant. Gebiet., p. 67, pl. vi. fig. 10, 1870.

Spicules.—I. Megascleres. 1. *Somal oxea*, 3·3 by 0·05 mm. 2. *Cortical oxea*, 0·96 by 0·04 mm. 3. *Protriæne*, rhabdome 5·18 by 0·03 mm.; cladi about 0·17 mm. long. 4. *Anatriæne*, rhabdome about 0·045 mm. in diameter.

II. Microscleres. None are present on the slide presented by Schmidt to the British Museum.

Habitat.—Florida; depth, 135 to 152 fathoms.

Remarks..—I give the dimensions of the spicules on the slide mounted by Schmidt as a contribution to our knowledge of this species. By itself this is quite insufficient to determine the species, and Schmidt's description is of no value whatever. The species must therefore remain doubtful till some one is fortunate enough to obtain access to the type. It appears to resemble *Craniella simillima*, Bowerbank.

Craniella tethyoides, O. Schmidt.

Craniella tethyoides, O. Sch., Spong. Atlant. Gebiet., p. 66, pl. vi. fig. 9, 1870.

Spicules.—I. Megascleres. 1. *Oxea*. 2. *Protriæne* (*?*). 3. *Anatriæne*, cladi 0·07 to 0·09 mm. long, chord 0·08 to 0·011 mm.

II. Microsclere. 4. *Sigmaspire*, surface raised into irregular rounded transverse ridges, 0·035 by 0·006 mm.

Habitat.—Florida; depth, 100 to 123 fathoms (not from Iceland?).

Remarks.—This is probably a good species, distinguished by the large and characteristic sigmaspire. Schmidt assigns specimens from Iceland to this species, but the mounted spicules in the British Museum do not support this determination.

Craniella zetlandica (Carter).

Tethya zetlandica, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. ix. p. 417, pl. xxii. figs. 1–6, 13–17, 1872.

Tethya cranium, var. *zetlandica*, Norman, Bwk., Mon. Brit. Spong., vol. iv. p. 39, 1882.

Sponge similar to *Craniella cranium*.

Spicules.—I. Megascleres. 1. *Somal oxea*, 4·6 by 0·06 mm. 2. *Cortical oxea* 1·1 by 0·05 mm. 3. *Protriæne*, rhabdome 5·3 by 0·018 mm. 4. *Anatriæne*, rhabdome 5·3 by 0·025 at the cladose end, rapidly diminishing to 0·013 mm.; cladi 0·08 mm. long, chord 0·013 mm.

II. Microscleres absent.

Habitat.—Shetland Islands.

Remarks.—This species very closely resembles both *Craniella simillima*, Bwk., and *Craniella cranium*, Lmk. From the latter it differs chiefly in the absence of sigmaspires, which are not present at any stage of its existence; that no other notable differences are correlated with this is a remarkable fact, suggesting grave suspicions as to the value of the sigmaspires for classificatory purposes. That their presence or absence is of sufficient value, at least for specific distinction, however, will, I think, be admitted, and we may, therefore, fairly recognise the validity of Carter's species, *Tethya zetlandica*, as opposed to *Tethya cranium*. When we come to compare *Craniella simillima* with *Craniella zetlandica* the case is different; neither of these species possesses sigmaspires, and the only characters on which a distinction can be made are the relative dimensions of the spicules. In the Challenger specimens of *Craniella simillima* the somal oxeas range from 2·85 by 0·028 to 3·37 by 0·047 mm., the cortical oxeas measure 1·4 by 0·04 mm., the latter are therefore larger than the corresponding spicules in *Craniella zetlandica*, the former smaller. Whether this difference is sufficient for the distinction of species appears to me very doubtful.

Fangophilina submersa, O. Schmidt.

Fangophilina submersa, O. Sch., Spong. Meerb. Mexico, p. 73, pl. x. fig. 3, 1880.

This evidently very interesting species is insufficiently characterised by Schmidt. It recalls in some sort the general appearance of *Cinachyra barbata*, Sollas.

Habitat.—Caribbean Sea.

Tabular View of the Tetillidæ.

	Oxea.		Protriæne.	Anatriæne.	Sigmaspire.	Microrhabd.
Genus *Tetilla*.						
I. Species without microscleres.						
1. *Tetilla antarctica* (Cr.),	1·25		present	present	...	...
2. *Tetilla pedifera*, Soll.,	3·2		2·4	4·5	...	...
II. Species with a single form of microsclere.						
(α) Simple sigmaspires under 0·02 mm. in length.						
3. *Tetilla dactyloidea* (Cr.),	1·35		1·43	12·0	8	...
(β) Simple sigmaspires over 0·01 and under 0·03 mm. in length.						
4. *Tetilla gravata*, Hyatt,	2·0		3·5	3·5	13	...
5. *Tetilla sandalina*, Soll.,	2·33		present	..	28	...
6. *Tetilla ridleyi*, n. n.,	2·5		present	present	16	...
7. *Tetilla coronida*, n. sp.,	3·4		3·4	7·14	16	...
8. *Tetilla arabica* (Cr.),	3·5		6·4	4·5	12	...
9. *Tetilla leptoderma*, Soll.,	4·3		4·0	7·5	20	...
10. *Tetilla casula* (Cr.),	5·0		10·12	absent	14	...
11. *Tetilla grandis*, Soll.,	6·0		8·6	31·5	12	...
12. *Tetilla polyura*, O. Sch.,	present		present	present	20	...
13. *Tetilla radiata*, Selenk.,	...		...	...	...	...
(γ) Simple sigmaspires over 0·03 mm. in length.						
14. *Tetilla robusta* (Cr.),	3·34		4·0	4·0	34	...
(δ) Sigmaspires centrotylote.						
15. *Tetilla geniculata*, Marenz.,	5·0		present	10·0	13	...
(ε) Sigmaspires spined.						
16. *Tetilla japonica*, Lampe,	4·0 and over		present	present	17	...
III. Species with two forms of microscleres.						
(α) No additional megascleres present.						
17. *Tetilla australiensis* (Cr.),	5·7		5·7	...	17	210
(β) Modified triænes also present.						
18. *Tetilla merguiensis* (Cr.),	4·2		6·17	6·17	11	250
(γ) Amphitriænes present.						
19. *Tetilla stipitata* (Cr.),	3·5		...	...	24	59
	Somal.	Cortical.				
Genus *Chrotella*.						
20. *Chrotella simplex*, Soll.,	3·0	...	3·4	5·3	12	...
21. *Chrotella macellata*, Soll.,	5·7	...	8·0	6·5	16	...
Genus *Cinachyra*.						
22. *Cinachyra barbata*, Soll.,	8·0	0·9	21·0	40·0	16	...
Genus *Craniella*.						
(α) Species without sigmaspires.						
23. *Craniella carteri*, Soll.,	2·56	...	3·5	6·75	...	...
24. *Craniella simillima* (Bwk.),	3·3	1·4	5·6	6·63	...	...
25. *Craniella lens*, O. Sch.,	3·3	0·96	5·18	present	...	...
26. *Craniella pulchra*, n. sp.,	4·6	1·2	7·1	present	...	...
27. *Craniella zetlandica* (Cr.),	4·6	1·1	5·3	5·3	...	...
28. *Craniella infrequens* (Cr.),	present	0·58	present	present	...	...
29. *Craniella insidiosa*, O. Sch.,	(incerta sedis)		...	...	...	...

Tabular View of the Tetillidæ—continued.

	Oxea.		Protriæne.	Anatriæne.	Sigmaspire.	Microrhabd.
	Somal.	Cortical.				
(β) Sigmaspires from 0·01 to 0·02 mm. in length.						
30. *Craniella abyssorum* (Cr.), .	4·3	0·7	4·3	6·5	20	...
31. *Craniella cranium*, auctt., .	2·1	0·83	3·2	2·1	9	...
	4·3	0·9	5·4	11·4	12	...
32. *Craniella schmidtii*, n. sp.,	2·2	present	present	present	20	...
(γ) Sigmaspires over 0·02 mm. in length.						
33. *Craniella tethyoides*, O. Sch.,	present	present	present	present	35	...
(δ) Sigmaspires large and spined.						
34. *Craniella atropurpurea* (Cr.),	3·57	1·25	5·0	5·0	62	...

The measurements give the length of the megascleres in millimetres, of the microscleres in micro-millimetres.

Family II. Samidæ.

Sigmatophora in which the characteristic megascleres are amphitriænes.

Genus *Samus*.

Samus anonymus, Gray.

Bowerbank, Spicule of an Unknown Sponge, Mon. Brit. Spong., vol. i. p. 234, pl. ii. figs. 41, 42.
Samus anonyma, Gray, Proc. Zool. Soc. Lond., p. 526, 1867.
„ „ Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. iii. pp. 350–352, pl. xxix. figs. 1–4, 1879.
Samus anonymus, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 59, 1880.

Sponge excavating.

Spicules.—I. Megascleres. 1. *Amphitriæne;* rhabdome cylindrical, 0·08 by 0·0375 mm.; cladome with trichotomate cladi; protocladi 0·043 mm. long, deuterocladi 0·075 mm. long.; chord 0·16 mm.

2. *Heteropolar amphitriæne;* rhabdome cylindrical, 0·0197 mm. long, the cladome at one end with simple cladi, at the other with trichotomate cladi; simple cladi 0·024 mm. long; trichotomate cladi, protocladi 0·016 mm. long, deuterocladi 0·016 mm. long.

II. Microsclere. 3. *Sigmaspire*, smooth, 0·012 mm. long.

Habitat.—Bahia.

Habitat.—Carter states that this sponge occurs in the West Indies, Australia (excavating *Millepora alcicornis*), the South Seas (in *Stylaster sanguineum*), and the Seychelles (in rooting fibres of *Euplectella cucumer*).

Remarks.—I owe to the kindness of Mr. Carter a mounted slide bearing spicules of an Australian example of this species; as in all other cases in which the sponge has been observed, it occurs in association with spicules, some of which are certainly foreign to it, and possibly all. The amphitriænes and sigmaspires are evidently proper to the sponge, but tylostyles are associated with these both in Mr. Carter's specimen from Australia and that of the Challenger from Bahia. Mr. Carter regards these tylostyles as derived from an associated *Cliona*; but there is just a possibility that this may not be the case; and if they really are proper to the *Samus*, this Bahian example would have to be assigned to a different species from the Australian ones, since in this latter the tylostyles measure 0·29 by 0·015 mm. in length and breadth, the tylus being 0·015 mm. in diameter, and in the former they measure 0·142 by 0·008 mm., with a tylus about 0·01 mm. in diameter. Associated with the spicules from Australia, I found a tylocladus derived probably from some species of *Acarnus* (Gray), but resembling the tylostyles in all respects except for the presence of the four cladi. The amphitriænes vary considerably in dimensions, hence there is some little difficulty in comparing by means of measurements those from different localities; a careful comparison of the Australian examples with those from Bahia showed, however, complete identity between the two.

There seems to be some little confusion attaching to Carter's stated measurements, they do not agree with those obtained from his figures, which are accurately drawn to scale. Thus, measurements made from the drawing of the amphitriæne give the following; rhabdome 0·067 by 0·0267 mm.; cladi 0·08 by 0·02 mm.; chord 0·16 mm., but, according to the text, the spicule is 0·28 mm. long by 0·11 mm. across the head. This is probably explicable as an accidental inversion of statement; it should, I think, read 0·11 mm. long, by 0·28 mm. across the head. The heteropolar amphitriæne is said to measure 0·042 mm. in diameter across the trichocladome; this is no doubt an average dimension, but I found one exceptionally large example, with a rhabdome 0·0276 by 0·0118 mm.; simple cladi 0·0474 mm. in length, and trichotomate cladi with the protocladus 0·0237 mm., and the deuterocladus 0·0276 mm. in length.

The length of the sigmaspire is given by Carter as 0·0083 mm., this is an average measurement also, the maximum length is the same as that of the similar spicules in the Bahian specimens, viz., 0·0118 mm. The minute spination of these forms and of the heteropolar amphitriænes described by Carter is not visible under a Zeiss's objective D. and is a character of no importance.

Amongst the very small, young amphitriænes I found two interesting examples which may throw some light on the origin of this form of spicule; one of them presented a slender rhabdome bearing two cladi at each end, those of the one end lying in the

same plane as those at the other; but the one pair are trichotomate and the other simple. The other presents a rhabdome 0·0118 mm. long, bearing two cladi as long as itself at one end, but terminating in a sharp point without branching at the other. The cladi each bear two very minute spines, one on each side, near the pointed extremity; in other words, they are trichotomous.

Both these forms suggest an origin from some microsclere similar in general character to the large asters of *Thenea*, or *Plakina*. Amongst the transitional forms from a spiraster to an oxyaster in *Thenea*, one frequently meets with examples in which a slender rhabdome bears two cladi at each end; if the rhabdome instead of shortening and aborting as in *Thenea* should increase in size and an additional cladus appear at each end, a simple form of amphitriæne would result. On the other hand, the occurrence of irregular amphitriænes in *Tetilla stipitata* suggests another origin for these forms, and they may have been derived from a triæne. The curved form of the cladi observed in the immature triradiate form of amphitriæne mentioned above, suggests the possibility of a third mode of origin. Let a sigmaspire pass into a sigma, and from analogy with the calcareous sigmata of Echinodermata and Nudibranchiate Molluses, we may expect this in some cases to develop an actine from the middle of its convex side. This would give a triradiate form, with two rays curved. Let these develop spines, one on each side of their termination, and the immature form of amphitriæne described results. Thus, there is considerable room for speculation on the mode of origin of these spicules, but without a basis of embryological data speculation is likely to prove barren.

Suborder II. ASTROPHORA.

Choristida in which one of the microscleres is some form of aster.

Demus I. STREPTASTROSA.

Astrophora in which one of the microscleres is some form of spiraster.

Family I. THENEIDÆ.

The ectosome never forms a cortex; the mesoderm is a collenchyma; the flagellated chambers eurypylous.

Thenea, Gray.

Theneidæ of symmetrical form, with one or more distinct oscules, and with specialised pore-areas, in addition to pores generally dispersed. The distinctive spicules are dichotriænes, which are arranged together with the other megascleres in radiating fibres.

Thenea delicata, Sollas (Pl. VI. figs. 10–20; Pl. VIII. figs. 9, 10).

Thenea delicata, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 185, 1886.

Sponge (Pl. VI. fig. 10) small and symmetrical, upper portion larger than the lower, obtusely conical, apically truncated by a single osculc, surface hispid; tegminal edge circular, fringed with hispidating oxeas; basal portion convex, apparently smooth, but rough to the touch; its dermal membrane passes imperceptibly into the fenestrated membrane of the equatorial recess, so that the lower margin of the recess is not externally defined; a lower fringe of hispidating spicules is not present; anchoring rootlets few, slender, thread-like, issuing abruptly from the basal surface. Flagellated chambers large; collenchyma comparatively scanty.

Spicules.—I. Megascleres. 1. *Oxea*, slender, fusiform, usually 4·83 mm., but sometimes 6·3 mm. in length by 0·0434 mm. thick.

2. *Protriæne*, rhabdome and cladi slender, cylindrical, sharply pointed; rhabdome 3·927 by 0·0197 mm.; cladi 0·35 mm. long.

3. *Dichotriæne*, of the usual form; rhabdome 4·82 by 0·065 mm.; protocladi 0·143 by 0·058 mm.; deuterocladi 1·07 by 0·058 mm.

4. *Somal anatriæne*, a short, slender, cylindrical rhabdome, and comparatively long, slender cladi, the latter curved outwards and backwards in a gentle regular arc, so that two of them seen together in outline form a semicircle; rhabdome 0·954 by 0·0075 mm., cladi 0·075 mm. long, spread 0·0876 mm.

5. *Radical oxytylote* (Pl. VI. figs. 11, 12), a long, slender, cylindrical rhabdome, sharply pointed at the proximal end, at the distal end swollen to form a more or less spherical tylus. The axial fibre of the rhabdome may either terminate simply within the tylus, or, as more frequently happens, it may give rise to three or fewer branching or bifurcating fibres, which thus remain to indicate its triæne nature; rhabdome 5·35 by 0·0387 mm., tylus 0·0645 mm. wide.

II. Microscleres. 6. *Plesiasters*, few and comparatively small. Actines minutely spined, 0·079 by 0·0079 mm.

7. *Amphiasters*, not very numerous, axis short and straight, giving off at each end a whorl of three or four spines, and a single spine in continuation of its own direction. Spines roughened, frequently somewhat tylote. The spicule is 0·0395 mm., the spines 0·0158 mm. long.

Colour.—Greyish-white.

Habitat.—Station 147, near the Crozet Islands, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; depth, 1600 fathoms; bottom, Diatom ooze; bottom temperature, 34°·2 F.

Remarks.—Three specimens of this delicate and symmetrical sponge were trawled, two of them measure 20 mm. in diameter, and from 16 to 18 mm. in height, the third

is a little smaller, viz., 18 mm. in diameter and 12 mm. in height. The oscule of one of the larger specimens is 3 mm. in diameter. The slender thread-like rootlets are about 25 mm. long. There are about four or five to each sponge. The oscule, which is not protected by a spicular fringe, leads into a wide almost spherical cloaca lined by a fenestrated membrane, beneath which are seen the circular openings of several small excurrent canals.

Horizontal transverse sections were prepared to determine whether any trace of radiate symmetry occurred in the arrangement of the excurrent canals. The result was negative, but the sections confirmed a suspicion suggested by an examination of the entire sponge both in this species and others, namely, that the excurrent canals near the oscule are bounded on the outer side by the ectosome only, as shown at *a*, fig. 10, Pl. VIII. It is possible that a membrane like that of which traces are shown at *b* may originally have existed, and subsequently been torn away or displaced in the preparation of the slices; but I could, at all events, detect no signs of it in any of them. If the appearances represented in the drawing are to be relied upon, we may suppose that after the folding of the choanosome which gave rise to the canal system, an upward growth of the sponge took place, in which the choanosome only incompletely participated, leaving only longitudinal zones of ectosome to complete the external covering of the excurrent canals.

In vertical transverse section (Pl. VI. figs. 13, 14) the regular radiate arrangement of the spicules is clearly shown (though not in the illustrations), as well as the interdigitation of the excurrent and incurrent canals, the latter starting chiefly from the poriferous zone as widely open channels which ramify within the substance of the sponge as they proceed.

The spicules are remarkably few in number, and this is true of all alike, from the oxeas to the amphiasters. The small size of the somal anatriæne is worth noting, though a similar reduction, but not to the same extent, occurs in some other species of the genus, *e.g.*, *Thenea wyvillii*.

Still more interesting is the transformation of the radical anatriænes; in most species of *Thenea* a few club-shaped spicules, which are reduced anatriænes, occur along with the normal anatriænes of the roots, but in this case all the spicules which compose the rootlets are of this form. Most frequently the axial fibre of the rhabdome after entering the tylus gives off three irregular fibres, either from the same point, not necessarily the end, or at different points along its course. These fibres are thinner than that of the rhabdome, swollen and constricted irregularly, and crooked in their course; they usually bifurcate, and frequently give off a number of small lateral branchlets which give them a ragged appearance. Frequently when they reach the surface of the tylus their termination is marked by a small rounded projection, suggestive of an aborted cladus. In other cases only two, or even one, branch may arise from the axial fibre, and sometimes branches are altogether absent. In this last case the spicule is in every

essential respect similar to the oxytylote so characteristic of *Esperia marshal-halli* (S. Kent).

Ectosome (Pl. VIII. fig. 9).—This may be regarded as that outer layer of tissue in which the subdermal cavities are included. On an average it measures 0·3 mm. in thickness. The subdermal cavities occupy the greater part of it; above them it is reduced to a dermal membrane 0·004 to 0·008 mm. thick; between them it forms pillars traversed by the megascleres, and connecting the dermal membrane with the choanosome. The collenchyma of the ectosome is of the normal type; and so well preserved that the union of the collencytes by the anastomosis of their branching processes into a continuous network is particularly well displayed. Some of the processes of the collencytes can be traced up to the epithelium, in which they appear to terminate,—in what way I could not precisely ascertain, but it appeared to be by coalescence with the epithelial cells.

The ectosome contains generally but few myocytes, which lie immediately below the outer epithelium tangential to the surface, and in the pillars of the subdermal cavities where they are radiately or longitudinally directed; but where it becomes modified to form the poriferous membrane of the equatorial recess, and the membranous margin of the oscule, myocytes constitute the greater part of it, so that in these regions the whole of the middle layer between the outer and inner epithelia may be regarded as a muscular sheet.

In the wall of the cloaca just below the oscular margin (Pl. VI. fig. 18), the collenchyma becomes modified by the abundant development in it of certain elements which elsewhere are only sparingly present (Pl. VI. fig. 19); these are more or less oval cells with very sharply defined outlines, from 0·02 to 0·04 mm. in diameter, enclosing one, two, or several more or less spherical vacuoles, in at least one of which is usually situated a deeply stained transparent globule, 0·004 to 0·008 mm. in diameter; probably of the same nature as similar globules described in my paper on *Thenea wallichii*.[1] The granular protoplasm of the cell forms a network of which the vacuoles are the meshes, and in one of its widest trabeculæ, from which the others radiate, is situated a nucleus, 0·012 mm. wide, enclosing a spherical nucleolus, 0·004 mm. in diameter, which is attached to the sides of the nucleus by radiating threads. The exterior of the cell is produced into slender branching processes like those of a collencyte, and it may possibly be regarded as a collencyte modified to form a reserve of nutriment (thesocyte).

Choanosome (Pl. VI. fig. 17; Pl. VIII. fig. 9).—The collenchyma of the choanosome is reduced to a minimum, being present as the merest film between adjacent flagellated chambers, and as a very thin layer forming the walls of the larger water-canals, which are without vela, and scarcely modified from their primitive character as spaces left by the folding of the sponge-wall; collenchyma also sparingly accompanies the spicular tracts.

[1] *Ann. and Mag. Nat. Hist.*, vol. ix. p. 447, pl. xvii. figs. 18, 19, 43–46, 1882.

Where the collenchyma is more abundantly developed, as in the angle formed between three adjacent chambers, it sometimes presents small, deeply-stained granular cells, 0·006 to 0·02 mm. in diameter, these are no doubt contracted amœboid cells.

The flagellated chambers are very perfectly preserved, so as to show every detail of structure. They measure about 0·087 by 0·067 mm.; the apopyle is from 0·012 to 0·032 mm. in diameter; the prosopyles are usually obliterated. The apopyle is situated in the midst of an excessively thin membrane, which is devoid of choanocytes, but bears evident though minute nuclei; it sometimes shows traces of concentric striation, and may attain a width of 0·018 mm. The darkly stained, more or less spherical bodies of the choanocytes are produced into a collum, defined by two parallel lines, which curve a little apart as they become continuous with the margin of a fenestra in the fenestrated lining. The fenestræ are about 0·006 to 0·008 mm. in diameter, and in the middle of each is frequently seen a little dark spot, which may represent the retracted flagellum. The body of the choanocyte is extended into thin thread-like lateral processes, by which adjacent choanocytes are united continuously together. In some regions of the sponge the flagellated chambers (Pl. VI. fig. 20) have suffered a contraction, by which the choanocytes are brought close together side by side, possibly through the contraction of their connecting processes; in such cases exceedingly tenuous tail-like processes, proceeding from the base of the choanocyte in an opposite direction to the collum, are rendered plainly visible; and what is of particular interest, these processes can be traced into continuity with those of the choanocytes of adjacent chambers, with the fine branching processes of the surrounding collencytes, and with the epithelial cells of neighbouring canals.

Thenea wrightii, Sollas (Pl. VIII. figs. 11–20).

Thenea wrightii, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 185, 1886.

Sponge (Pl. VIII. figs. 11, 12) depressed, with flat or very obtusely conical upper surface, and flat base. Margin more or less lobate, rounded over the lobes, where the upper and lower surfaces pass insensibly into each other, thus interrupting the equatorial recess and converting it into a series of circumscribed poriferous areas.

Neither the oscule, which is excentrically placed on the upper surface, nor the pores, are protected by a marginal fringe of projecting spicules.

Rootlets absent, but the lower surface strongly hispid. Flagellated chambers large. Collenchyma scanty.

Spicules.—I. Megascleres. 1. *Oxeas* fusiform, of the usual characters; a stout form 5·4 by 0·07 mm., and a longer and more slender form 8·57 by 0·055 mm.

2. *Protriæne*, rare, and then evidently a reduced dichotriæne.

3. *Dichotriæne*, of the usual character; rhabdome 5·0 by 0·0645 mm.; protocladi 0·286 by 0·0645 mm.; deuterocladi 1·07 by 0·058 mm.

4. *Anatrianes* (Pl. VIII. fig. 13) of one form only, rare; a long rhabdome, of which no complete example has been observed, and three conical widely extended cladi; rhabdome 0·03 mm. wide; cladi 0·138 by 0·0276 mm., chord 0·21 mm.

5. *Oxytylote;* a long stout conical rhabdome sharply pointed at the proximal end, at the distal end swollen into a rounded tylus, within which the axial fibre terminates abruptly without branching. One example measured 6·06 mm. by 0·095 mm. in width just below the tylus; the tylus is 0·115 mm. in diameter, and the axial fibre terminates 0·059 mm. from its end; a second example is shorter but with a thicker tylus, 3·2 mm. by 0·087 mm.; tylus 0·1302 mm. in diameter, the axial fibre terminates 0·075 from the end.

II. Microscleres. 6. *Oxyasters* (Pl. VIII. figs. 14–19), large and exceedingly numerous. The actines are long and stout, one actine of a tetrad form 0·197 by 0·0237 mm.; of a triad 0·21 by 0·025 mm.; of a dyad 0·258 by 0·024 mm.

7. *Metaster;* predominant form, a short slender axis curved once, with comparatively few long spines, proceeding from its convex side and in whorls near its ends. Total length of the spicule 0·0355, of a single spine 0·016 to 0·02 mm.

8. *Spiraster;* predominant form, a slender spire with spirally arranged spines having a roughened surface; total length 0·0355, of a single spine 0·008 to 0·015 mm.

Colour.—White with a somewhat yellowish-brown tinge.

Habitat.—Station 302, off west coast of South America, December 28, 1875; lat. 42° 43′ S., long. 82° 11′ W.; depth, 1450 fathoms; Globigerina ooze; bottom temperature, 35°·6 F.

Remarks.—Of this species, which by reason of its lobate margin and flattened form is one of the most curiously modified examples of the genus, six specimens were trawled. The largest is a cake-like mass, flattened above and below, with strongly lobate margins, the poriferous areas being confined to the sides of the lobes or the sinuses between them. It measures 50 by 35 mm. in length and breadth, and only 8 mm. in thickness; the other specimens are not so depressed as this, one measures 35 by 27 mm. in length and breadth, and 17 mm. in height or thickness, and another 30 by 27 mm. and 11 mm. In all the excurrent canals near the upper surface are plainly visible through the skin as dark channels, which radiate in stellate fashion from the oscule, subdividing as they approach the margin of the sponge.

Beneath the fenestrated membrane there is as usual a sinus or large subdermal cavity, from which the incurrent canals originate, their communication with the sinus being guarded by a sphinctral velum.

The ectosome varies from the thin skin covering the subdermal cavities to a layer 0·19 to 0·395 mm. in thickness, where it forms the pillars connecting this roof with the choanosome. The collenchyma of the ectosome contains in places collencytes, in which, enclosed within a spherical vacuole, is a darkly stained finely granular mass of reserve

nourishment. The collenchyma of the choanosome is reduced to a minimum; the flagellated chambers being separated from each other by the thinnest film. In size these chambers measure about 0·079 by 0·063 mm.; the fenestrated membrane which is produced by the concrescence of the collars of the choanocytes is remarkably well shown, appearing as an inner second wall to the chambers, separated from the true wall by an interval of about 0·016 mm. Its fenestræ, round or oval in outline, vary from about 0·0118 to 0·008 by 0·006 mm. in length and width. The choanocytes are arranged in quincunx, stand about 0·0075 mm. apart, and are connected by protoplasmic threads.

The oxyasters are large and present a great variety of forms—monactines (tylostyles) (Pl. VIII. fig. 19); diactines (microxea), straight, or more usually angulate (Pl. VIII. fig. 18); triactines (triods) like the triradiate spicules of calcareous sponges (Pl. VIII. fig. 16); tetractines (microcalthrops) like those of *Dercitus* (Pl. VIII. fig. 15); pentactines and hexactines (Pl. VIII. fig. 14) like those of Hexactinellid sponges, and divers other forms. They are thickly crowded together, as in *Thenea schmidtii*, giving to the sponge quite a Pachastrellid or Plakinid appearance. The metasters are very similar to the spirasters, the latter as usual are most abundant in the ectosome.

Thenea grayi, Sollas (Pl. VI. figs. 21, 22).

Thenea grayi, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 183, 1886.

Sponge (Pl. VI. fig. 22) with a more or less flattened summit and rounded base, which in young forms is hemispherical. Oscule large, rounded, laterally placed, and defended by a thick fringe of oxeate spicules, the projecting ends of which are longest over the upper margin and become shorter as they descend to the lower margin of the opening. The oscule leads into a somewhat hemispherical depression, or cloaca, which is lined by a smooth, poriferous, or fenestrated membrane. Poriferous area also lateral, restricted to one side of the sponge, opposite to the oscule, elongated laterally, defended by a fringe of projecting spicules, which are most abundant over the upper margin. Rootlets few and slender, surface of the sponge not produced into conical projections at the points whence they issue. Flagellated chambers of medium size, 0·063 mm. in diameter.

Spicules.—I. Megascleres. 1. *Oxea*, slender, fusiform, straight or curved, 10·07 by 0·026 mm., and a stouter form 7·8 by 0·08 mm., the former forms the spicular fringes, the latter the spicular fibres within the sponge.

2. *Protriæne*, a stout rhabdome 5·88 by 0·087 mm., with three strong, more or less undulating conical cladi 0·828 by 0·083 mm.

3. *Dichotriæne* of the usual form; rhabdome 5·8 by 0·087 mm.; protocladi 0·238 by 0·0725 mm.; deuterocladi 1·193 by 0·059 mm.

4. *Somal anatriæne*, a short, slender rhabdome, rounded at the proximal end,

1·07 by 0·006 mm.; cladi curving from the rhabdome at a wide angle and then bending nearly into parallelism with it, 0·048 mm. long; chord 0·09 mm.

5. *Radical anatriænè*, a long, slender rhabdome, with a stout cladal end, and three stout conical cladi projecting from it. Rhabdome 10·33 by 0·0175 mm.; cladi 0·09 by 0·012 mm.; chord 0·123 mm.

II. Microscleres. 6. *Plesiaster*, small, with slender actines; a single actine 0·143 by 0·0118 mm; this spicule is present in considerable numbers.

7. *Metaster*; of the usual characters: the axis is about 0·004 to 0·008 mm. long, the spines 0·032 by 0·004 mm.

8. *Spiraster*, spire stout, 0·0118 mm. long, with spirally arranged spines, 0·0158 mm. long, smooth or roughened, sharply pointed or slightly tylote; total length 0·039 mm.

Colour.—Greyish-white.

Habitat.—Station 164c, off Sydney, June 13, 1874; lat. 34° 19′ S., long. 151° 31′ E.; depth, 400 fathoms; bottom, green mud; bottom temperature, 40°.

Remarks.—Three specimens of the sponge were dredged, one larger and two smaller; all possess the same characteristic form, which is also met with in specimens, probably referable to *Thenea muricata*, Bwk., from the North Atlantic. The largest specimen is 35 mm. wide by 19 mm. high, and 19 mm. broad, or including the spicular fringe to the oscule and special poriferous recess 33 mm. broad. The two smaller specimens are about 17 by 14 mm. wide and 16 mm. high.

The ectosome is an extremely thin dermal layer except where it forms the pillars to the subdermal cavities, where it attains a thickness of from 0·06 to 0·12 mm., and over the summit of the sponge, where it forms an irregular layer from 0·05 to 0·13 mm. thick. A local thickening also takes place about the margins of the poriferous recess; the poriferous membrane presents the usual structure.

The choanosome consists chiefly of the flagellated chambers; collenchyma is scanty, though not so deficient as in *Thenea delicata*; it forms a wall to some of the canals, as much as 0·08 mm. thick. The canals are also provided with vela. The flagellated chambers are mostly spherical, but frequently they lie so close together as to become polygonal by appression. The plesiasters which lie among them are so disposed that their rays lie tangentially between adjacent chambers. The chambers are not large, from 0·05 by 0·055 mm. to 0·063 by 0·063 mm.: the apopyle is about 0·017 mm. in diameter. A quantity of granular stained material occurs in many of the chambers and is abundant in the canals. I take this to be ingested food material.

The spirasters are most abundant beneath the outer epithelium, the metasters in the choanosome; both are highly variable in form and dimensions.

Parasite.—A curious instance of commensalism occurs in this sponge; situated in

the walls of the incurrent canal, which starts from the poriferous recess, is a simple form of Hydroid, lying with its tentacles just below the surface of the canal and its basal end extending inwards amongst the flagellated chambers. It is about 0·3 mm. long by 0·05 mm. broad at the oral end. The cavity of the collenchyma in which it lies is lined by the epithelium of the sponge and opens by a somewhat constricted aperture into the canal. I have more than once found Hydroids overgrowing the surface of a sponge, but never before met with one inhabiting the interior.

Thenea schmidtii, Sollas (Pl. VII. figs. 1, 2; Pl. VIII. figs. 21, 22).

Stelletta agariciformis, O. Schmidt, 1870, Spong. Atlant. Gebiet., p. 68, pl. vi. fig. 12.
Tisiphonia agariciformis, O. Schmidt, Spong. Meerb. Mexico, 1880, p. 71.
Thenea schmidtii, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 183, 1886.

Sponge (Pl. VII. fig. 1) more or less spherical in form; special poriferous area either restricted to one side, opposite the oscule, which is then also lateral, or surrounding the sponge as an equatorial recess, which divides an upper portion, bearing one or more oscules, from a lower, which is produced into anchoring filaments. Surface hispid, margins of poriferous and oscular areas fringed by projecting spicules. Collenchyma but scantily developed in the choanosome; flagellated chambers large.

Spicules.—1. Megascleres. 1. *Oxea*, fusiform, sharply or bluntly pointed, straight or curved, 14·3 by 0·079 mm. The hispidating oxeas of the oscular margin and the tegminal edge are usually more slender (from 0·045 to 0·06 mm. thick) than those of the body-fibres, from which the foregoing measurements are taken. In a specimen with a lateral poriferous area I found the distal ends of these spicules preserved in several instances; and they proved to be not oxeas but protriænes, the cladi of which are liable to reduction, sometimes all but one disappearing, in others all, a club-like thickening (tylus) then replacing them.

2. *Protriæne;* rhabdome conical, straight or flexuous, with straight conical cladi diverging outwards and forwards. Rhabdome 5·4 by 0·071 mm.; cladi 1·07 by 0·063 mm.

3. *Dichotriæne;* rhabdome straight or irregularly flexuous, sharply or bluntly pointed; protocladi diverging outwards and forwards, deuterocladi tangential. Rhabdome 9·3 by 0·087 mm.; protocladi 0·175 mm. long; deuterocladi 1·5 by 0·055 mm.

4. *Somal anatriæne;* rhabdome cylindrical, with a sharply pointed or rounded end; actines diverging at first almost at right angles, subsequently somewhat suddenly bent backwards, till nearly parallel with the rhabdome. Rhabdome 17·9 by 0·02 mm.; cladi 0·143 by 0·008 mm.; chord 0·12 mm.

5. *Radical anatriæne;* rhabdome as in the preceding; cladi curving backwards and outwards from their origin, thicker, and more divergent than those of the somal

anatriænes; rhabdome swollen in the angle of the cladi. Rhabdome 21·5 by 0·025 mm.; cladi 0·196 by 0·025 mm.; chord 0·19 mm., length of the cladome 0·065 mm.

II. Microscleres. 6. *Oxyaster* or *plesiaster*. The actines usually diverge from a common centre; a single actine of a tetrad form in three different specimens of the sponge gave the following measurements; 0·175 by 0·017 mm., 0·197 by 0·0276 mm., and 0·205 by 0·0177 mm. This spicule is very abundant.

7. *Metaster;* of exceedingly various forms, passing from the spiraster into the plesiaster.

8. *Spiraster;* this is about 0·032 mm. in total length; it presents a short spire about 0·008 mm. long, with spirally arranged slender spines, each about 0·012 mm. long.

Colour.—Almost white; faintly grey.

Habitat.—Station IV., west of Gibraltar, January 16, 1873; lat. 36° 25′ N., long. 8° 12′ W.; depth, 600 fathoms; bottom, blue mud.

Station 24, off Culebra Island, March 25, 1873; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 73, near the Azores, June 30, 1873; lat. 38° 30′ N., long. 31° 14′ W.; depth, 1000 fathoms; bottom, Pteropod ooze; bottom temperature, 39°·4.

Also, according to Schmidt, Florida, 198 fathoms.

Remarks.—Four perfect specimens and some fragments of this sponge were obtained; the largest specimen, from Station 73, is 47 mm. high by 55 mm. broad; another from the same station is scarcely smaller, viz., 52 mm. high by 47 mm. broad. Each possesses but a single oscule, which is large, 7 mm. in diameter in the largest specimen. A smaller specimen from Station IV. presents two oscules, or rather three, if a very small one be taken into account. Around the margin of the oscules there is in all the agariciform specimens a smooth annular area 2 to 3 mm. wide (in the case of the largest specimen), white, and translucent owing to the presence of collenchyma beneath it, and furnished with no spicules except spirasters; outside this is the fringe of hispidating spicules, which point towards the centre of the oscule when it is situated on the summit of the sponge; when, on the contrary, it lies on one side, only the upper half of the fringe is developed, and the spicules point downwards, overhanging the oscule.

The spicular fringe of the poriferous recess is chiefly developed along the tegminal edge, and is directed downwards; when the lower margin of the recess is also provided with fringing spicules these also point downwards. The pores of the poriferous membrane are remarkably coarse in the specimens from Station 73, many of them measuring as much as 1 mm. in diameter; those of the specimen from Station IV. are much smaller.

The oscule is surrounded by collenchyma containing numerous concentric muscular fibres; it leads at once into a short wide canal which divides into several branches; these secondary canals are wide and open, not provided with a thick collenchymatous wall, nor

repeatedly constricted by vela. They exhibit no trace of a regular radiate arrangement; and can be traced continuously from the oscule to the equatorial sinus, from which they are excluded by the thinnest of membranes, and in some cases this membrane is absent, so that the excurrent canal becomes freely continuous with the incurrent sinus. It appears to me that this must be the result of accident.

The equatorial sinus is the bottom of the equatorial recess, covered in by the poriferous membrane; the floor of the sinus presents several large, more or less circular openings; the mouths of the chief incurrent canals, which, originating as wide open tubes, extend into the interior of the sponge repeatedly ramifying in their course.

The flagellated chambers (Pl. VII. fig. 2) are large; the following are measurements —0·05 by 0·035 mm., 0·067 by 0·055 mm., 0·067 by 0·063 mm., and 0·09 by 0·09 mm. The apopyle is about 0·035 to 0·04 mm. in diameter.

External gemmation (Pl. VIII. fig. 21).—Several little ovate or club-shaped bodies, about 1·25 mm. long by 0·75 mm. broad, were observed seated on the hispidating spicules of specimens from Station 73. Sometimes they form a swelling at the end of a spicule, sometimes they surround it in the middle like a bead on a needle. They closely resemble structures which Carter first alluded to as adhering to *Tisiphonia* (*Thenea*) *agariciformis*,[1] and which Vosmaer has since described in connection with *Thenea muricata* from the Arctic Seas, and which he regards as buds. Serial sections were prepared of several of them, all of which displayed the same structure. Exteriorly they are invested with epithelium in continuation with that of the rest of the sponge with which they are associated. Within this is a solid mass of collenchyma traversed by a vast number of small granular fusiform cells, which drift chiefly in a longitudinal direction, but which are also partly transverse, partly spiral in arrangement. Microscleres, plesiasters, and spirasters are also present, plentifully scattered throughout the collenchyma.

The structure figured by Hansen[2] as a new genus and species of sponge, *Clavellomorpha minima*, appears to be very similar to this, but is much larger, being as much as 5 mm. in length and proportionately wider. I was at first disinclined to regard these bodies as buds, but after an examination of the admitted buds of *Tethya*, that possess a precisely similar structure I see no room for doubt. It follows that the canal system with its lining of pinnacocytes and choanocytes is developed from solid collenchyma. There is no evidence of the migration of endodermic cells into the buds, and the collenchyma, like the mesenchyme of so many sponge-embryos, may therefore be regarded as a potential endoderm.

Young Sponge (Pl. VIII. fig. 22). Small ovate bodies occur detached from, but entangled amongst the anchoring spicules of the same specimens as furnished the buds just described. One measuring 1·68 by 1·11 mm. was sliced in serial sections.

[1] *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xviii. p. 405, 1876.
[2] Norwegian North Atlantic Expedition, vol. xxv. p. 117, pl. v. fig. 4, 1885.

The ectosome appears in these as a continuous outer investment, not in the least folded, but as even in its curvature as the shell of an egg. The choanosome on the contrary is folded within it in a complex manner, so that the excurrent and incurrent canals, or rather cavities, are already produced in various orders of size, the smallest in communication with the flagellated chambers. The collenchymatous mesoderm is very poorly developed either in choanosome or ectosome; it is thickest where the folds of the former, bulging outwards, become continuous with the latter, producing the earliest formed pillars of the subdermal cavities, which are represented at this stage by the incurrent cavities or sinuses left between the ectosome and the choanosome by the folding inwards of the latter. These cavities also represent the rudiments of the incurrent canals, so that we can hardly yet speak of the subdermal cavities as differentiated from the incurrent canals. The folding of the choanosome evidently takes place in complete independence of the ectosome, and for its accomplishment we must either suppose a rapid ingrowth of epithelium from the pores of the latter following the retreating folds of the former, or we must suppose a genuine cleavage to occur between the two layers, and at present we have no evidence to decide this point. Appearances are in favour of cleavage, which, judging from general embryological data, we might regard as a substitute for the invagination which we know to occur in other forms of sponges.

Spicules are already present in the young sponge, anatriaenes were not seen, but otherwise all the spicules characteristic of the adult were observed; of course they are very diminutive.

The species of *Thenea* are so liable to variation that it is often difficult to find good characters for them, or to feel sure in all cases whether one is dealing with a species or a variety. I rank *Thenea schmidtii* as a species because the characters which distinguish it are constant throughout a series of specimens, which in other respects, such as external form, are very variable, and which were obtained from several different localities. The same is true of the other North Atlantic species, *Thenea muricata*, but it will possibly require the examination of many more specimens than have come under my observation before the distinction of *Thenea schmidtii* and *Thenea muricata* can be regarded as fully established.

The following is a summary of the characters in which they differ:—

1. *Plesiaster.*—This spicule is larger and much more abundant in *Thenea schmidtii* than in *Thenea muricata*. In the latter its numbers sink into insignificance beside those of the spirasters, in the former it is as numerous as those spicules or more so, and plays quite as important a part in the skeleton of the sponge as the tetrad spicules do in *Dercitus* and its allies. This relative abundance characterises specimens of very different size and external form.

2. *Mesoderm.*—This is richly developed in *Thenea muricata* (Pl. VII. fig. 3), forming a thick wall about all the canals, and converting them by its velar extensions into

a series of vesicles; no other *Thenea* approaches it in the abundance of this tissue, except *Thenea wyvillii*. In *Thenea schmidtii* it is comparatively scanty, even the main canals being but sparingly provided with it.

3. *Flagellated Chambers.*—These are considerably larger in *Thenea schmidtii*, being on the average of about twice the diameter of those of *Thenea muricata*.

4. *Distribution.*—*Thenea muricata* is a northern species, found in company with *Craniella cranium*, auctt. *Thenea schmidtii* is a more southern form, with which *Craniella schmidtii*, n. sp., is associated.

There may be a slight difference in colour between the two species, *Thenea schmidtii* being nearly white, and *Thenea muricata* a very evident grey, but I lay no stress on this.

With regard to the differences which exist between different specimens of *Thenea schmidtii*, they are chiefly differences of external form and size—some resembling *Thenea grayi*, and others being agariciform—and in the dimensions of the plesiaster, though not in its relative abundance. The rays of the plesiaster in specimens from Station IV. (depth, 600 fathoms; bottom, blue mud) are almost twice the thickness of those from Station 73 (depth, 1000 fathoms; bottom, Pteropod ooze); it is to be supposed that the difference in the size of the plesiaster, in different examples of what has every appearance of being the same species, is due to some difference in local conditions, but from so small a basis of observation, one cannot connect it with the difference observed to exist in the depth and character of the sea-bottom.

It only remains to explain the adoption of "*schmidtii*" as the specific name of the sponge. I avoided the designation "*agariciformis*" because Schmidt did not at first call his Floridan specimens by this name, but simply stated that they resemble *Tisiphonia agariciformis*, Thomson, and he refrains from describing them because Thomson had previously sent him examples and plates illustrative of this sponge. As the Florida specimens are probably of the species just described, and Thomson's is the northern form *Thenea muricata*, it would lead to confusion to credit Schmidt with Thomson's name; while all uncertainty is avoided by the adoption of a new one.

Thenea fenestrata (O. Schmidt) (Pl. VIII. figs. 1–8).

Tisiphonia fenestrata, O. Schmidt, Spong. Meerb. Mexico, p. 71, Taf. x. fig. 2.

Sponge (Pl. VIII. fig. 1) cushion-shaped with an oval margin; upper surface rounded, rising in the middle into a conical eminence, truncated by the oscule at the summit. An equatorial series of poriferous areas (six to seven in number), separated by intervals where the upper and lower surfaces pass insensibly into each other over a rounded edge. As a rule only one large incurrent canal originates in the cavity lying beneath each poriferous sieve.

The oscule is protected by a dense conical fringe of projecting oxeas; spicular fringes

also defend the upper and lower margins of the poriferous areas; the upper fringe is directed downwards over the area and over the lower fringe; this also is directed downwards and therefore away from the area. The skin of the sponge is produced about the proximal part of the fringes, both of the oscule and poriferous areas, thus converting them into membranous tubes.

The rootlets are small, without basal cones, for the most part torn away.

In young forms the sponge resembles *Thenea grayi* in form, the oscule is lateral and a single poriferous area is situated on the opposite side; additional poriferous areas appear to be added with growth.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 5·0 by 0·06, and 9·3 by 0·05 mm.

2. *Protriæne* of the usual form, with long conical cladi curving forwards; rhabdome 3·9 by 0·052 mm.; cladi 0·785 by 0·04 mm.; chord 1·4 mm.

3. *Dichotriæne* of the usual form; rhabdome 3·14 by 0·03 to 0·05 mm.; protocladi 0·163 by 0·04 to 0·045 mm.; deuterocladi 0·678 by 0·032 mm.

4. *Somal and radical anatriænes* (Pl. VIII. figs. 2, 3) of the same form. A slender cylindrical rhabdome with slender, sharply-pointed, much recurved, cladi; in specimens from Station 106 the rhabdome is frequently produced beyond the cladal origin for a variable distance, so as to give rise to a mere mucrone or tubercle, or a long rod-like spine, either rounded off or sharply pointed at the end; in other words the cladome is subterminal to mesactinal in position. Rhabdome 4·641 to 5·56 (probably often longer) by 0·0125 mm.; cladi 0·4 by 0·0115 mm.; chord 0·239 mm.; distal prolongation of the rhabdome from 0·0 to 0·357 mm. long.

II. Microscleres. 5. *Plesiaster* (Pl. VIII. figs. 4–5) small, with slender actines obviously spiral, seldom monocentral; actines often minutely spined; a single actine 0·06 to 0·09 by 0·0039 mm.

6. *Spiraster* (Pl. VIII. figs. 7, 8) large, a spire with numerous spirally arranged spines, sometimes roughened, and sometimes slightly tylote; total length from 0·0395 to 0·0474, length of a single spine 0·0012 to 0·0019 mm.

Metaster; absent.

Colour.—Yellowish-white (Station 123); greyish-white (Station 106).

Habitat.—Station 106, south-west of Sierra Leone, August 25, 1873; lat. 1° 47′ N., long. 24° 26′ W.; depth, 1850 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·6.

Station 123, off Macio, September 11, 1873; lat. 10° 9′ S., long. 35° 11′ W.; depth, 1715 fathoms; bottom, red mud; bottom temperature, 37°.

Specimens described by Oscar Schmidt were obtained from Bequia at 1507 and 1591 fathoms; and from lat. 24° 36′ N., long. 80° 5′ W., at 955 fathoms.

Remarks.—In giving an account of *Thenea muricata*, Bwk., I suggested that

Thenea fenestrata, O. Sch., had no more right to specific distinction than some of the abnormal varietal forms of the former species;[1] Vosmaer, in a subsequently published paper,[2] expresses very decidedly the same opinion; I had not at that time examined specimens of *Thenea fenestrata*, and had, like Vosmaer, to depend solely on Schmidt's descriptions, which were inadequate, the sole distinction between this and allied species to be elicited from them being one of external form merely. The Challenger specimens having afforded me additional information, I am now prepared to recognise the species as valid.

At Station 106 four or five specimens were trawled, one fairly large and full grown, the others small and apparently young forms. The large specimen measures 44 by 35 mm. in length and breadth and 24 mm. in height. The oscule is central, concealed by its surrounding fringe of spicules, the upper and lower surfaces are smooth, except to touch. The poriferous areas, seven in number, are elliptical, with their long axes directed equatorially, and about 10 mm. long, they are well defended by long spicular fringes. The upper fringe of spicules is sometimes united to the lower by a single fibrous thread, apparently muscular, and if so serving to close the upper fringe like a lid on the lower.

The smaller specimens all differ in form from the larger, the oscule being lateral and not more than one or two poriferous areas being present, they occur on the margin opposite the oscule. Schmidt describes similar forms amongst those he examined, and appears to attribute their divergence from the typical form to a difference in age. In full-grown examples the poriferous areas number from five to seven, according to Schmidt.

At Station 123 a whole specimen and a fragment were obtained; the former is almost perfectly symmetrical in shape; its, on the whole, elliptical margin measures 49 by 31 mm. in length and breadth, its height is 20 mm. There are six poriferous areas, their margins are produced into membranous tubes; and they are regularly arranged three at each end of the elliptical margin, as though at the corners of an elongated hexagon. In the middle of the upper surface is the conical membranous cloacal tube bearing the oscule with its long spicular fringe. So strikingly radiate is the whole appearance of this sponge that it is fortunate, as preventing vain analogies, to find that the number six as regards the poriferous areas is not rigidly adhered to in other specimens. The specimens from the two different stations are remarkably similar to each other in all respects; the chief differences are to be found in the absence of the terminal mucrone from the anatriænes of the specimens of Station 123, and in the greater thickness of the spicules generally in the specimens from this locality. The plesiasters and spirasters are similar in both.

The ectosome is a well-developed layer of irregular thickness, sometimes as much as

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ix. p. 436, 1882.

[2] Report on the Sponges of the "Willem Barents" Expedition, *Nied. Archiv f. Zool.*, Suppl., Bd. i., 1882.

0·25 mm. across; it undergoes a considerable thickening at the margin of the poriferous recesses, and is continued inwards as a wall to the incurrent canals. The choanosome is amply supplied with collenchyme, which forms a wall to the main excurrent canals and their branches, except those into which the flagellated chambers open. The chambers are fairly large, 0·06 by 0·04 to 0·065 by 0·055 mm. The plesiasters occur chiefly in the walls of the canals, where they are so situated that two or more of their rays extend parallel to the surface of the canal, and one projects from it at right angles; so that the cavity of the canal is echinated throughout.

The spiraster occurs in the choanosome as well as the ectosome; it varies in dimensions, especially in the length of its spines.

Thenea wyvillii, Sollas (Pl. VI. figs. 1–9).

Thenea wyvillii, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 184, 1886.

Sponge (Pl. VI. figs. 1, 2).—Upper surface rounded, cushion-like or flat; equatorial margin sharp, thin, and not provided with a spicular fringe; projecting considerably over the lower surface, which is produced into large conical processes from which several strong roots are continued downwards as short fibres, which splay out at their lower ends and lose themselves in a dense mass of tangled spicules forming a basal support. The oscule in the centre of the upper surface is the open mouth of a wide, somewhat shallow basin-like depression or cloaca, which is lined by a delicate, smooth, minutely perforate membrane, below which the numerous excurrent canals open by small circular mouths, arranged more or less in vertical or radial series. The minute perforations of the cloacal membrane are sometimes replaced—either along the oscular edge or generally—by large oval fenestræ, radially elongated and serially arranged, within which the excurrent canals open, one or more to each fenestra, by a sphinctrate aperture. The equatorial poriferous membrane, of which the pores are unusually small, is very finely, closely, and regularly striated, owing to the close and regular disposition of its supporting fibrous strands.

Although the equatorial membrane is continuous round the sponge, the equatorial sinus is broken up into a number of subsidiary cavities by the frequent attachment of the membrane to the underlying tissue.

The incurrent and excurrent canals are lined by a thick layer of collenchyme. Flagellated chambers eurypylous, from 0·032 to 0·04 by 0·051 mm. in diameter.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, usually curved, sharply pointed, 7·85 by 0·07 mm. to 0·084 mm.

2. *Protriæne*, with short conical cladi, straight or slightly undulating; sometimes reduced to two or even one in number; rhabdome 6·783 by 0·072 mm.; cladi 0·5 mm. long.

3. *Dichotriæne* (Pl. VI. fig. 4) of the usual form, except as regards the rhabdome,

which is always irregularly undulating or crooked. Rhabdome 4·28 by 0·0968 mm.; protocladi 0·1785 by 0·08 mm.; deuterocladi 0·535 by 0·064 mm.

4. *Somal anatriæne* (Pl. VI. fig. 5), a short, slender, cylindrical rhabdome, rapidly tapering to a sharp point proximally; cladi long, slender, springing at a wide angle from the rhabdome, and afterwards recurving till nearly parallel with it; rhabdome 0·876 by 0·0079 mm.; cladi 0·95 mm. long; chord 0·1 mm.

5. *Radical anatriæne* (Pl. VI. fig. 6), a very long, slender, sharply pointed rhabdome, terminating distally in a thickened end, from which three stout conical cladi recurve backwards and outwards; rhabdome 18·2 by 0·025 mm. at the level of the cladal angle, diminishing to 0·016 mm. at the level of the ends of the cladi, and 0·011 mm. for the greater part of its length; length of the cladal end of the rhabdome 0·04 mm.; cladi 0·1 by 0·014 mm.; chord 0·095 mm. The rhabdome may in some cases be longer; the above is the length of the longest complete anatriæne which I have observed.

II. Microscleres. 6. *Plesiaster* (Pl. VI. fig. 8), the multiradiate forms often closely approach the monocentral type, but seldom quite reach it; and in most cases their spiral character is very obvious. There is the usual variety in the number of the actines, from six or more down to one. One actine of a tetrad form measures from 0·08 to 0·09 by 0·0118 mm.

7. *Metaster* (Pl. VI. fig. 7), axis very short, usually straight, sometimes slightly curved; spines slender, about four to ten in number, each about 0·02 mm. long.

8. *Spiraster;* a slender spire of about three to four turns, with numerous slender spines, spirally arranged; total length 0·02 to 0·025 mm.; length of a single spine 0·004 mm. The spirasters are chiefly distributed below the epithelium of the exterior of the sponge.

Colour.—White, with a yellowish-grey tinge.

Habitat.—Station 209, off Zebu, January 22, 1875; lat. 10° 14′ N., long. 123° 54′ W.; depth, 95 fathoms; bottom, blue mud; bottom temperature, 71°.

Also Zebu (Sollas on *Thenea wallichii*, *loc. cit.*, p. 451).

Remarks.—This handsome sponge forms a well-marked species, distinguished by its general form, the characters of its oscular and poriferous areas, and the unusually thick and crooked shaft of its dichotriæne. The rich development of collenchyma and the smallness of its flagellated chambers are characters which it shares with *Thenea muricata* only.

Three specimens (one uninjured and complete) and several fragments were observed. The upper moiety (pileus) of the perfect specimen measures 50 by 47 mm. along two diameters, its total length from base to summit is 68 mm., the thickness of the body of the sponge is 26 mm. The cloaca, an elongated depression, is 23 by 14 mm. in breadth and width, the lining membrane is minutely perforated and without fenestræ. The second almost complete specimen is more circular in outline as seen from above, the

cloacal depression is also somewhat circular in outline and measures 13 mm. in diameter. The lining membrane is fenestrated by large oval openings along the edge of the oscule, and minutely perforated over the remaining central portion. The third specimen is rendered somewhat abnormal in form by the flatness of its upper surface, which is an almost mathematical plane bordered by a sharp circular edge. Since the upper surface does not as usual curve downwards over the equatorial poriferous area, the latter rises steeply up to meet it. The diameter of the upper surface is 21 mm., of the cloaca 6 mm. The cloacal membrane of this specimen, and of some of the remaining fragments, is fenestrated all over, one or more excurrent canals opening within each fenestra.

In transverse section the numerous small excurrent canals are seen terminating beneath the cloacal membrane, with which their walls become continuous; along the line of union the walls are somewhat thickened, so that the end of the canal is dome-shaped. In the centre of the dome, in the fenestrated specimens, is a sphincterate aperture. The skeleton has a regular radiate arrangement; and, on dissecting away the equatorial poriferous membrane, the underlying thin spicular fibres are seen crossing the underlying zone in close regular series at right angles to the equatorial edge, which they enter, and slightly deploying out as they reach their insertion along its margin, form a disc of contiguous spicules, on which the support of the thin sharp equatorial edge depends.

The membrane of the cloacal depression appears imperforate to the unaided eye. It may be dissected and examined under the microscope, when it is found to be riddled with small pore-like apertures varying from 0·016 to 0·318 mm. in diameter. Beneath this poriferous membrane is a second thicker layer of tissue, raised over its upper surface into a polygonal network of low ridges, the summits of which unite with the overlying poriferous membrane, while within the depressed areas of the meshes are the openings of the excurrent canals.

Ectosome (Pl. VI. fig. 9).—This has the usual structure, consisting of a layer of collenchyme containing in addition to the usual collencytes fusiform myocytes; where it forms the poriferous roof of the incurrent canals, it has a maximum thickness of 0·04 mm., and consists of an upper and lower layer of epithelium, succeeded by collenchyme containing a single row of spirasters above and below; in the middle is a layer of myocytes, 0·012 mm. thick. Where it forms the pillars about a subdermal cavity it may attain a thickness of 0·14 to 0·2 mm.

Choanosome (Pl. VI. fig. 9).—The mesoderm is a typical collenchyme; it forms thick walls about the incurrent and excurrent canals; in one instance a canal with a lumen 0·24 mm. wide is surrounded by a wall of collenchyme 0·37 mm. thick. By transverse extensions of the walls, the canals are constricted at intervals so as to form a succession of vesicles, and, as usual in such cases, the velar diaphragms are provided with concentrically arranged myocytes and act as sphincters.

The abundant development of collenchyme leads to a marked decrease in the number of flagellated chambers, and, in accordance with a very general rule, to a decrease in size also. They still, however, remain eurypylous, the apopyle measuring about 0·012 mm. in diameter. They lie in immediate contact with the walls of the smaller incurrent canals, which, devoid of any marked collenchymatous investment, and surrounded with flagellated chambers, can be traced into the midst of a mass of collenchyme bounded externally by two excurrent canals. The smaller excurrent canals, on the other hand, excavate the collenchyme which lies on the excurrent side of the chambers. The chambers and the smaller canals are frequently filled with a granular material which stains with eosin and gives a very dirty appearance to sections; it would appear to be food in process of digestion or egestion.

With regard to the arrangement and distribution of the microscleres, it may be noted that the plesiaster is confined chiefly to the neighbourhood of the flagellated chambers, seldom extending into the collenchymatous walls of the canals; the metasters are chiefly scattered in a layer beneath the epithelium of the canals, and the spirasters are chiefly confined to the under surface of the epithelium of the surface of the subdermal cavities.

The figure given of the metaster (Pl. VI. fig. 7) is not characteristic, and I regret that no illustration appears of the spiraster; in its absence I would refer as an excellent substitute to that of the spiraster of *Dactylocalyx masoni* given by Bowerbank.[1]

Thenea sp. (Pl. VIII. fig. 23).

Sponge (Pl. VIII. fig. 23).—Small, ovate; surface hispid; excurrent canals opening in a cribriform area which occupies the summit, and which is surrounded by a marginal fringe of long oxea; incurrent canals communicate with the exterior by pores generally dispersed; no specialised poriferous area; base marginally fringed with projecting spicules, the distal ends of which are broken off.

Spicules.—I. Megascleres. 1. *Oxea*, cylindrical with pointed ends; no unbroken specimens met with; 0·044 mm. in diameter.

2. *Protriæne*, a stout cylindrical rhabdome, proximal end not seen; cladi stout and long, curving outwards and forwards at first, then forwards only, or forwards and slightly inwards; diameter of rhabdome 0·055 mm., cladi 0·95 by 0·043 mm., chord 0·7 mm.

3. *Dichotriæne*, of the usual form; protocladi 0·18 by 0·045 mm.; deuterocladi 0·93 by 0·039 mm.

4. *Anatriæne*, a cylindrical rhabdome with a sharply pointed end; cladi diverging outwards and backwards; rhabdome 2·71 and longer by 0·013 mm.; cladi 0·24 mm. long; chord 0·24 mm.

[1] *Proc. Zool. Soc. Lond.*, pl. vi. fig. 4, 1869.

II. Microscleres. 5. *Plesiasters* of the usual form; single actine of a tetrad form, 0·079 by 0·004 mm.

6. *Metasters*, spines about 0·019 mm. long.

7. *Spirasters*, a slender spire with comparatively few long, slender, pointed spines; spire 0·012 mm. long, spines 0·012 mm. long, total length 0·032 mm.

Colour.—Brownish-grey.

Habitat.—Station 297, off west coast of South America, November 11, 1875; lat. 37° 29′ S., long. 83° 7′ W.; depth, 1775 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·5.

Remarks.—Only a single specimen of this sponge was trawled; it is small but perfect, 4 or 5 mm. in height, and 3 mm. in diameter, excluding the projecting spicules. It is probably a distinct species, but as from its small size it may be supposed to be immature, I refrain from giving it a separate name. The main excurrent canals descend vertically from the cribriform area at the summit; they are provided with thick collenchymatous walls, constricted at intervals by velar diaphragms, and riddled with lateral openings leading into branch canals. The ectosome is about 0·02 to 0·04 mm. thick. The greater part of the choanosome is occupied by the flagellated chambers, which in their expanded state measure as much as 0·055 mm. when spherical, and 0·059 by 0·043 mm. when oval in section. Many of them are contracted, and then exhibit the backward extension of the body of the choanocytes into a long filament which has been described previously (*vide, Thenea delicata*, p. 63, Pl. VI. fig. 20).

The specimen differs from other species of *Thenea* in the absence of a special poriferous area, but this is probably a mark of immaturity; in the presence of a basal fringe of hispidating spicules, which appear to take the place of rootlets; and in the presence of numerous protriænes, which are rare in other species of the genus. The presence of an additional character (that of the basal fringe), coinciding with the absence of a common character (that of a special poriferous area), led me to think that what I took for the base might really be the special poriferous area, and the basal fringe the spicules surrounding it, I therefore searched for some signs of a poriferous area in this position in my thin slices, but could not detect any. It seems very possible that this may be the young form of *Thenea wrightii*.

Thenea sp.

A small and fragmentary sponge, evidently not adult; the spicules are similar to those of *Thenea muricata*. As it is without characteristic features, I think it sufficient to record its occurrence. It may possibly be a young form of *Thenea wyvilli*.

Habitat.—Station 218, near the Admiralty Islands, March 1, 1875; lat. 2° 33′ S., long. 144° 4′ E.; depth, 1070 fathoms; bottom, blue mud; bottom temperature, 36°·4.

Genus 2. *Pœcillastra*,[1] n. n.

Normania, Bowerbank, Brit. Assoc. Rep., p. 328, 1868.

Thenciдæ not possessing specialised poriferous recesses; usually of plate-like form, bearing incurrent pores on one face, and small evenly dispersed oscules on the other. The megascleres are not radiately arranged; and, in addition to triænes occupying the usual position, calthrops are present within the choanosome. The microscleres are microxeas and spirasters, the former forming a loose felt throughout the sponge.

Pœcillastra schulzii, Sollas (Pl. IX.).

Normania schulzii, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 185, 1886.

Sponge (Pl. IX. fig. 1).—A thick plate-like growth, with rounded margins, erect, flabelliform or vase-shaped; attached; surface even; rough to touch; pores on the outer side in generally dispersed cribriform areas; oscules small, evenly dispersed on the inner side; excurrent canals, small and numerous, entering the wall more or less transversely, separated by intervals usually less than their own diameter from each other near their oscular terminations.

Flagellated chambers various in size, the largest about 0·0395 mm. in diameter when circular in section, and 0·0355 by 0·0434 mm. when oval. Apopyle 0·0158 mm. in diameter.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. IX. fig. 2), straight or slightly curved, not very sharply pointed; 3·57 by 0·071 mm.

2. *Oxea* (Pl. IX. fig. 3), slender, cylindrical, sharply pointed, irregularly curved; 4·28 by 0·013 mm.

3. *Orthotriæne* (Pl. IX. fig. 4). With straight, conical, sharply pointed rhabdome and cladi; cladi slightly projecting forwards, sometimes retroflexed or bent laterally (Pl. IX. fig. 16) near the ends; rhabdome 0·714 by 0·071 mm.; cladi 0·357 mm. long.

4. *Calthrops* (Pl. IX. fig. 5), of the usual form; actines 0·4 by 0·048 mm.

II. Microscleres. 5. *Microxea* (Pl. IX. figs. 6, 19–21), fusiform, sharply pointed, curved or somewhat sharply bent in the middle, roughened or minutely spined or smooth; 0·129 by 0·00395 mm.

6. *Metaster* (Pl. IX. figs. 8–13), axis curved once, bearing spines on the convex side and at the ends, or straight and spined at the ends only; rarely reduced to a plesiaster with three or four spines. Total length 0·0316 mm., of a single spine 0·0138 mm.

7. *Spiraster* (Pl. IX. figs. 14, 15), spire of about two or three revolutions, extended on the outer side into a lamella or ala, bearing short, rod-like, abruptly truncated spines

[1] ποικίλος, variegated, various.

at its edge, radiately arranged with respect to the spire; the length of the spicule does not exceed 0·02 mm., of a single spine 0·004 mm.

Colour.—White, with a faintly yellowish tint.

Habitat.—Station 150, Heard Island, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; depth, 150 fathoms; bottom, coarse gravel; bottom temperature, 35°·2.

Remarks.—This species is readily distinguished from *Pacillastra* (*Normania*) *crassa*, Bwk., by the dimensions of its spicules and the characters of its canal system. The fusiform oxea (1) and the triæne (3) have twice the length and breadth of the corresponding spicules in *Pacillastra crassa*; and the oscules are small, numerous, evenly dispersed, while in *Pacillastra crassa* there are several somewhat large oscules congregated together. Two complete specimens and fragments of a very large one occur in the collection. Of the complete specimens, the larger is represented on Pl. IX. fig. 1. It measures 100 mm. in height, 85 mm. in breadth, and is 9 mm. thick. The other and smaller one is more irregular in form; a somewhat fan-shaped plate, irregularly undulating, raised in places into irregular ridges, and with sinuous margins. It measures 42 mm. in height, 53 mm. in width, and 4 to 5 mm. in thickness. The fragments consist of several plate-like pieces, and one in which a plate-like wall has grown from a linear attached base into a wide tube of an oval section, 72 by 43 mm. in diameter. It appears to form the basal part of a cup, of which the remaining pieces helped to form the wall; part of the sponge, however, has been lost, as I could not build the pieces together into a complete form. From the reconstruction I effected, the whole sponge would appear to have been a vase at least 160 mm. high, and 160 mm. broad. The wall is about 8 mm. in thickness. The pores, 0·09 to 0·1 mm. wide, occur several together in oval groups, each group forming a fenestrated membrane, which roofs over a circumscribed subdermal cavity—in other words, the origin of an incurrent canal; this is broken up below by numerous partitions of collenchyme, coated by epithelium, into several smaller incurrent canals. The oscules occur as single apertures, 0·16 to 0·318 mm. in diameter, in the centre of a membrane which roofs over the ends of cavities in the ectosome in which the excurrent canals terminate. This and the poriferous membrane are supported by oxeate spicules lying tangentially, and by the extended arms of the triænes, the rhabdomes of which descend through the ectosomal pillars. Beneath the epithelium of these membranes is a layer of thickly evenly dispersed spirasters, which extend up to the margin of the pores and oscules, their spines projecting beyond. Beneath these, again, microxeas occur, which tangentially surround the margins of the oscules and the poriferous areas, but do not extend to the extreme edge. The subdermal cavities of the incurrent face are irregular, winding, branching canals, from which the incurrent canals take their origin, extending transversely through the sponge-plate in the opposite direction to that of the excurrent canals, which extend inwards from the oscules. The course of both sets of canals, though

on the whole transverse, is exceedingly irregular in detail, as shown by the illustration (Pl. IX. fig. 26). The ectosome is not clearly defined from the choanosome; on the incurrent face, where it includes the subdermal cavities, it may attain a thickness of 0·64 mm., but this is often reduced to 0·24 mm. or less by the presence of flagellated chambers in the pillars, which unite the roof of the subdermal cavities with the floor. The collenchyme of the ectosome is continuous with that which forms the walls of the larger canals, and, of course, no line of demarcation between the ectosomal and choanosomal collenchyme exists.

The thick collenchymatous layer which lies beneath the epithelium of most of the large canals forms a large, perhaps the larger part, of the tissue of the sponge. Its distribution appears to be capricious; in the case of some of the larger canals it is almost absent. So far as I can make out, these canals are incurrent, but it is not as a rule absent from the incurrent canals; about many of them it exists as a thick wall.

The collencytes of the collenchyme are usually so disposed that the majority of their slender processes lie at right angles to the nearest epithelial surface; thus they are radiately arranged in the walls of the canals. Frequently one sees a more or less fusiform collencyte running at right angles to the epithelium, in which at one end it terminates, while the other end extends inwards and unites with a process of a stellate collencyte, which is in continuity also with other similarly situated fusiform collencytes, and with more deeply seated stellate or other forms. Eventually the collencytes are brought into continuity with the choanocytes (Pl. IX. figs. 25, 27), and thus the epithelium of the canal walls as well as of the exterior is in protoplasmic continuity with the choanocytes of flagellated chambers.

In addition to collencytes, the collenchyme contains two other kinds of cells; the one (Pl. IX. fig. 29) very numerous, deeply stained, more or less oval in outline, and about 0·025 mm. in diameter, consists of minute spherical bodies, about 0·004 mm. in diameter, having in optical section the appearance of double contoured rings surrounding a clear central space. These cells, abundantly scattered through the collenchyme, and particularly abundant on the margins of the regions occupied by flagellated chambers, are perhaps the most conspicuous elements in the sponge. They are not modified collencytes, but may possibly be symbiotic Algæ, or perhaps pigment cells.

The other kind (Pl. IX. fig. 25) is far from uncommon, though less abundant than the preceding; it is chiefly found in the neighbourhood of the flagellated chambers, frequently occupying a distinct cavity in the collenchyme lined by epithelium; in some cases this cavity appears to be that of a canal. These cells are oval or irregular masses of protoplasm, coarsely granular and darkly stained, about 0·03 mm. in diameter, produced at the periphery into long, thick, branching, pseudopodia-like processes, which burrow between the flagellated chambers, amidst which we lose sight of them. Within the cell is situated a large, oval, clear vesicle or nucleus, about 0·012 mm. in diameter,

enclosing a spherical, darkly stained translucent nucleolus 0·004 mm. in diameter, which is connected with the walls of the nucleus by radiating processes. These cells have somewhat the appearance of the large elements of nervous ganglia, so much so that a distinguished zoologist on seeing them for the first time exclaimed, "Cells from the spinal cord!" It is scarcely probable, however, that they are nervous in function; they are "too good to be true," *i.e.*, we should expect such large and striking cells to exist in evident connection or association with nervous tracts, and to occur more usually in other and similar sponges. They appear to me to resemble the large amœboid cells which I previously described in *Thenea wallichii* (*loc. cit.*, p. 448, pl. xvii. fig. 48), but in a different state of extension. Of probable hypotheses as to their nature there are three open to us: they may be parasites, or immature ova, or amœboid wandering cells. If parasites, they can only be Protozoa, and we should expect to find other stages of their life-history represented, but we do not: the same is true if we regard them as ova, they are so large that we should expect to find some examples in that stage in which they present a regular oval outline, but we do not; if they are wandering cells, they are much larger than those cells are usually; and they do not appear to wander, since they lie in distinct cavities, and their pseudopodial extensions are thread-like towards their extremities and not lobose, as is usually the case in wandering cells. The possibility of their being nervous elements must by no means be disregarded.

The flagellated chambers (Pl. IX. fig. 29) are usually spherical in form, and about 0·04 mm. in diameter; they occur in areas frequently bounded on all sides, in thin slices of the sponge, by collenchyme, but the ultimate branches of the canals in direct communication with them are without any special collenchymatous investment, and the chambers are truly eurypylous.

Skeleton.—As in all species of *Pœcillastra*, the spicules are not united together in fibrous tracts, though they sometimes lie parallel to one another in groups. The large oxeas tend to run more or less transversely and longitudinally through the sponge, the longitudinal spicules diverging obliquely outwards as they proceed upwards. Some lie tangentially beneath the skin, others are directed at right angles to it, their distal ends either lying below the epithelium, which often rises tent-like over the points, as much as 0·15 to 0·25 mm. beyond the general surface, or they perforate it and protrude as hispidating spicules.

The calthrops lie within the choanosome, irregularly disposed, though there is a tendency for their actines to lie tangentially to the surface of the adjacent canals. The orthotriænes are disposed with their cladi tangential to the surface, the rhabdomes radiating from it at right angles.

The spirasters are most abundant immediately beneath the external epithelium, but are not confined to it. The metasters are generally distributed through the sponge, but are rare beneath the outer epithelium.

The microxeas are scattered in considerable numbers through the collenchyme, but are not abundant enough to form a felt.

Spongin.—Where the large spicules touch each other they are sometimes united by a small quantity of spongin, which is developed around the point of contact. When the spicules are separated from each other the spongin remains adherent to one of them in the form of a little cup; several such cups are sometimes to be met with on one and the same spicule (Pl. IX. fig. 28).

Pœcillastra crassiuscula, Sollas.

Normania crassiuscula, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 185, 1886.

Sponge.—A thick vertical plate, outer incurrent face even, ending sharply above along a well-marked linear edge; inner excurrent face rounded off above against the incurrent edge; raised into rounded eminences, each bearing a single oscule. Both surfaces sparingly hispid. Incurrent canals running more or less vertically upwards to terminate in the patent oscules. Pores distributed in sieve-like areas over the origin of the incurrent canals, which cross the sponge wall more or less transversely.

The flagellated chambers measure 0·0355 by 0·0395 mm. in length and breadth.

Spicules.—I. Megascleres. 1. *Oxea*, stout, fusiform, not sharply pointed, straight or more usually curved, 2·856 by 0·058 mm.

2. *Orthotriæne*, with conical somewhat sharply pointed rhabdome and cladi, rhabdome not much longer than the cladi, both of about the same diameter. Rhabdome 0·678 mm., cladi 0·607 mm. long, both 0·0387 mm. in diameter.

3. *Calthrops*, of the usual form, one actine 0·65 by 0·048 mm. Both this and the orthotriæne comparatively rare.

II. Microscleres. 4. *Microxea*, slender, straight, or gently curved, 0·136 by 0·00395 mm.

5. *Metaster*, numerous, frequently reduced to a plesiaster with four actines. One actine of a tetractinose plesiaster measures 0·0198 by 0·00197 mm.

6. *Spiraster*, numerous, spire with several turns, spines numerous, total length 0·0197 mm., length of a single spine 0·004 mm.

Colour.—Greyish-white.

Habitat.—Porto Praya, St Iago; depth, 100 to 128 fathoms.

Remarks.—Both in general character and minute anatomy this sponge closely resembles *Pœcillastra schulzii*, the chief difference lying in the longitudinal course taken by the excurrent canals in the present species. It is represented by a single fragmentary specimen, which is perfect, however, as regards the upper margin, the basal part being that which has disappeared. It measures 19 mm. in height, 10 to 14 mm. in thickness, and 30 mm. in width, but was wider when complete.

The ectosome, including the subdermal cavities, is 0·079 mm. in thickness.

The spirasters are not confined to the immediate vicinity of the outer epithelium, but occur throughout the sponge.

Pœcillastra laminaris, Sollas.

Normania laminaris, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 186, 1886.

Sponge.—A thin irregular lamellar expansion. Inner surface even, regularly pitted by minute circular depressions, rounded off above as it approaches the outer surface; outer surface faintly striated by subdermal oxeate spicules longitudinally disposed; raised into irregular longitudinal ridges and rounded prominences; terminating above where it meets the inner face in a sharply marked margin, which is fringed with slender oxeate spicules projecting 4·5 mm. beyond it. A few hispidating spicules in addition are present here and there over the whole outer face.

Spicules.—I. Megascleres. 1. *Oxea*, stout, fusiform, not sharply pointed, frequently with one or both ends rounded off; 3·5 by 0·0516 mm.

2. *Oxea*, long, slender, cylindrical, projecting to form the marginal fringe; 5·3 by 0·008 mm.

3. *Orthotriænes*, rhabdome straight, conical, sharply pointed; cladi similar; rhabdome 0·678 by 0·06 mm.; cladi 0·357 by 0·06 mm.

4. *Calthrops*, similar to the triænes, sometimes with all four actines approximately equal, sometimes with one much elongated in the direction of the spicular bundle in which it lies. The ends of the actines or cladi in both calthrops and triænes frequently rounded off, sometimes quite close to their origin, so as to become reduced to mere tubercles. One actine of an isoactinate calthrops measured 0·636 by 0·063 mm.

II. Microscleres. 5. *Microxea.* Of the usual form; 0·145 by 0·004 mm.

6. *Metaster.* Of the usual character, frequently reduced to a plesiaster with three or four actines: spines rough and sometimes tylote; one spine measures 0·0150 mm.; total length 0·0197 mm.

7. *Spiraster.* Abundant and stout, spire with numerous short spines, blunt or abruptly truncated at the ends, spirally arranged; total length 0·0197 mm.; of a single spine 0·0039 mm.

Colour.—Greyish-white.

Habitat.—Off Amboina, 1000 fathoms.

Remarks.—Several fragments of this sponge are in the collection; the largest measures 103 mm. in length by 90 mm. in breadth; when placed together they form a plate 155 mm. wide and 110 mm. high, but whether originally they all formed parts of one individual or not I do not feel at all sure. The thickness of the plate varies from about 4 to 5 mm.

The lamellæ are slightly curved; the concave may be spoken of as the inner face, the convex as the outer. Beneath the skin of the inner face is a network of subdermal canal-like cavities, running in a crooked course, chiefly longitudinally, *i.e.*, radially from the base, and branching and anastomosing laterally. A similar but more widely marked network of subdermal canals occurs over parts of the outer surface. The skin of the inner surface is perforated by oval apertures from 0·08 mm. in diameter to 0·254 by 0·334 mm., one or sometimes two lying in an area of membrane bounded by the arms of adjacent triænes and tangentially disposed oxeas. The pore-bearing area is depressed within the spicular framework, and this produces the regular pitting already mentioned as characteristic of the inner surface. That of the outer surface is perforated by more numerous and smaller apertures about 0·05 by 0·08 mm. in diameter, several lying together in the areas bounded by adjacent spicules. On removing the skin from the inner face, the open ends of transverse canals of small but somewhat uniform diameter are exposed; on removing the skin from the outer face, the open ends of canals are similarly displayed, but these are of less uniform size, many being much larger than those of the inner faces.

The oxeate spicules and triænes are much subject to a rounding-off of the ends; in one instance the usually slender, sharp-pointed microxea was found to have undergone the same modification; the ends, which are roughened, are rounded off, at some distance from what would have been their normal position, and in addition the spicule has become swollen in the middle (centrotylote), so that it presents a very close resemblance to the centrotylote oxea, which occurs as the sole microsclere of some other sponges.

The spirasters are present in a dense layer below the outer epithelium, and do not appear to be present elsewhere, metasters replacing them in the interior. The microxeas are far less numerous than in *Pœcillastra tenuilaminaris*.

In minute structure and the arrangement of the spicules the sponge resembles *Pœcillastra schulzii*; the flagellated chambers measure about 0·0276 to 0·0316 mm. in diameter.

Pœcillastra tenuilaminaris, Sollas (Pl. V. figs. 17, 18).

Normania tenuilaminaris, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 186, 1886.

Sponge (Pl. V. figs. 17, 18).—A very thin lamellar wall 3 to 3·5 mm. thick, irregularly curved, with an irregularly sinuous rounded margin; surface generally but sparingly hispidated by projecting oxeate spicules; no special hispidating fringe at the margin; oscules minute, distributed evenly over one face of the sponge; pores similarly dispersed over the opposite face.

Spicules.—I. Megascleres. 1. *Oxea*, stout, fusiform, straight or curved, not sharply pointed, frequently rounded at one or both ends, and so reduced either to styles or a short cylindrical strongyle; 3·4 by 0·042 mm.

2. *Orthotriæne* and *Calthrops* of the usual characters; actines or cladi frequently rounded off into short rods or tubercles: rhabdome of triæne 0·5 mm. long; cladi 0·464 by 0·045 mm.

II. Microscleres. 3. *Microxea*, straight or curved, sharply pointed, surface roughened; 0·136 by 0·005 mm.

4. *Metaster*, very numerous, of every variety of form, passing into plesiasters of four actines, in which the actines may attain a length of 0·02 mm.; those with a straight or once-curved shaft, and more numerous spines spirally arranged, are about 0·0237 in total length, and the spines are about 0·008 mm. long.

Colour.—Yellowish or greyish-white.

Habitat.—Station 236, June 5, 1875: lat. 34° 58′ N., long. 139° 29′ E.; depth, 775 fathoms; bottom, green mud; bottom temperature, 37°·6. Trawled.

Remarks.—Three small fragments of this sponge, all from the same station, are the only specimens obtained. The largest fragment is 20 mm. broad by 20 mm. wide. Its distinction from *Pacillastra laminaris* rests not only on the greater thinness of its sponge-wall, but also on the absence both of a marginal fringe of hispid spicules and of spirasters.

The canals cross the wall transversely, those of one side alternating with those of the other; they are comparatively wide, but largely filled up by collenchyme, which crosses them in irregular vela.

The flagellated chambers are about 0·0237 by 0·0316 mm. to 0·0316 by 0·0473 mm. in diameter.

The abnormal forms of the calthrops are very numerous; it may be reduced to tri-, di-, or monactinose forms, the monactine or style frequently becoming spherically enlarged (tylostyle) at the end from which the lost actine has disappeared; the diactinose or rhabdus form is frequently swollen in the middle about the actinal origin; on the other hand, additional actines may be abnormally present; there may be five—four in one plane directed along two rectangular axes and the fifth at right angles to them,—or six, of which five may lie in one plane. These various forms resemble those of the plesiasters in *Theneа*, but while the plesiasters chiefly afford instances of reduction, the modifications of the calthrops are produced by increase as well as decrease in the number of actines. Given a spicule liable to vary, and under the action of the tensions existing in the sponge actines will be suppressed or developed in accordance with the tensions, and thus similar forms may be evolved from different starting points.

The orthotriænes are most abundant at the upper margin of the sponge, where they lie close together, with the cladi tangential to the surface, and the rhabdome descending at right angles to it into the interior, in the manner usual with triæne spicules.

Genus 3. *Sphinctrella*, O. Schmidt.

Sphinctrella, O. Schmidt, Spong. Atlant. Gebiet., p. 65, 1870.
Vulcanella, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 186, 1886.

Theneidæ in which the pores are generally dispersed, but the oscules few and highly specialised, each the large patent opening of a shallow cloaca, which is lined by a coarsely fenestrated membrane; spicules as in *Pœcillastra*.

Sphinctrella cribrifera, Sollas. (Pl. X. figs. 13–20.)

Vulcanella cribrifera, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 186, 1886.

Sponge (Pl. X. fig. 13*a*) more or less ovate; lower half (Pl. X. fig. 14*a*) embedded in a specimen of *Calthropella geodioides*, Carter. Upper half bearing one or more large round oscules (Pl. X. fig. 16), each surrounded by a marginal fringe of long oxeate spicules, the patent opening of a wide shallow cloaca, which is lined by a somewhat coarsely fenestrated membrane, covering the termination of the excurrent canals. Surface hispid. Canals with thick collenchymatous walls. Flagellated chambers 0·04 mm. in average diameter.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. X. fig. 17), stout, fusiform, straight or curved, not sharply pointed; 3·035 by 0·0671 mm.

2. *Oxea*, long, slender, cylindrical, sharply pointed, straight or curved; 7·5 mm. and over, by 0·0316 mm.

3. *Orthotriæne* (Pl. X. fig. 18), rhabdome straight, sharply pointed, with the cladi diverging chiefly outwards, scarcely at all forwards, usually bluntly pointed, or with the ends rounded. Rhabdome 1·0 by 0·0395 mm., cladi 0·25 by 0·0316 mm.

4. *Calthrops*, isoactinate with conical pointed actines, each from 0·286 by 0·0395, to 0·636 by 0·08 mm.

5. *Strongyle*, straight or curved, terminating abruptly in rounded ends (sausage-shaped); 0·357 by 0·0276 mm. This form is confined to the margin of the cloaca.

II. Microscleres. 6. *Microxea*, slender, fusiform, sharply pointed, straight or curved, of very various dimensions, from 0·011 mm. and upwards in length.

7. *Metaster* (Pl. X. fig. 20, the upper one of the two figures), very various in form, sometimes reduced to the plesiaster type; spines often 0·0118 mm. long.

8. *Spiraster* (Pl. X. fig. 20, the lower one of the two figures), a slender spire of several turns, with slender spirally arranged spines; 0·016 to 0·02 mm. in total length, a single spine from 0·002 to 0·004 mm. long.

Colour.—Brown.

Habitat.—St. Iago, Porto Praya, Cape Verde Islands, August 1873; depth, 100 to 128 fathoms.

Remarks.—Several individuals of this species occur embedded in the specimen of *Calthropella geodiides*, Carter, described on page 110. The largest, which bears three oscules, is 37 mm. long, 25 mm. broad, and 10 mm. high. The oscules, usually oval, measure about 9 by 6 mm., the depth of the surrounding fringe of oxeate spicules is 7 mm. and over. The fringe is sometimes erect, but more often very obliquely inclined, sloping over the oscule on one side, and away from it on the other. The margins of the oscule are produced over its base into a short tube, an extension of the cloaca.

The cribriform membrane of the cloaca is attached below to the margins of the terminal apertures of the excurrent canals. Along the line of attachment it is not perforate, and this imperforate tissue forms a kind of framework enclosing oval sieve-like areas, which cover the ends of the excurrent canals. The fenestræ of the sieves vary from 0·16 to 0·024 by 0·34 mm. in diameter.

The ectosome is vaguely defined from the choanosome; and subdermal cavities are not present.

The mesoderm is a collenchyme of the ordinary type: it forms thick walls about the chief canals, which are frequently constricted by vela, and so converted into a succession of vesicles. The flagellated chambers open by wide mouths into the ultimate excurrent canals which are not thickly lined by collenchyme; indeed, the regions occupied by the chambers are remarkably poor in this tissue, the chambers lying closely contiguous, so that the existence of the mesoderm between them is scarcely apparent, and best indicated by the metasters which accompany it. The chambers measure from 0·032 by 0·036 mm. to 0·036 by 0·051 mm.

Skeleton.—The chief constituents are microxeas, which, from dimensions no greater than usual, increase to such a size that it is difficult to delimit them from the immature megascleral oxeas. They thus present a striking instance of the passage of a microsclere into a megasclere. They are very irregularly distributed, forming a loose felt. On the whole, there is a tendency to take up a position tangential to the walls of the canals. The size of the spicule seems to depend to a great extent on its position; it is checked by meeting the opposition of a free surface—thus, when it lies parallel to the axis of a canal it may attain a considerable length, but when it runs transversely to two epithelial surfaces facing each other, it will not exceed the distance between them in length.

The spirasters are most abundant in the ectosome, beneath the outer epithelium, but they also occur beneath the epithelium of the main canals, where these are furthest removed from the exterior. The metasters are most abundant in the choanosome, though they are sparingly present beneath the outer epithelium. The oxeas are distributed quite irregularly within the sponge, only becoming radiate in direction close to the surface; as already mentioned, around the oscule they project far beyond the surface. The calthrops are irregularly distributed also, but the orthotriænes lie radiately, their cladomes tangential to the surface, and the rhabdomes at right angles to it. The "sausage"-

shaped strongyles lie transversely to the hispidating spicules, in the walls of the cloacal tube. It does not appear quite certain that they are proper to the sponge. The characters of the oscules clearly distinguish this sponge from *Pacillastra*, and, recognising this, I substituted a new genus, *Vulcanella*, to receive it. Subsequently I came to recognise the similarity in the characters of its oscules and those of *Sphinctrella*, O. Schmidt; and as it was upon these very characters that Schmidt seized on founding his genus, there can be but little doubt as to the identity of *Vulcanella* and *Sphinctrella*; on the other hand, the species *Sphinctrella cribrifera* and *Sphinctrella horrida* appear to differ considerably in form and general characters.

Sphinctrella gracilis, n. sp. (Pl. XLII. figs. 1, 2).

Sponge, incrusting. Oscules large, circular, surrounded by an erect fringe of long oxeas, closed by a thin membrane resembling a velum. Pores (?).

Spicules.—I. Megascleres. 1. *Oxea*, stout, fusiform, straight or curved, sometimes irregularly bent, not sharply pointed; 3·8 by 0·1 mm.

2. *Oxea*, long, slender, cylindrical, sharply pointed, straight or curved; 5·6 and over by 0·015 mm.

3. *Calthrops*, seldom quite isoactinate; actines conical, pointed, 0·83 by 0·064 mm.

II. Microscleres. 4. *Microxea* (Pl. XLII. fig. 1), fusiform, slightly curved, sharply pointed, surface raised into an irregular spiral ridge or a succession of annular ridges, for the middle one-third or two-thirds of its length; 0·35 by 0·0115 mm.

5. *Microxea*, fusiform, slender, sharply pointed, smooth, curved, usually somewhat suddenly bent in the middle, 0·14 by 0·004 mm.

6. *Spiraster* (Pl. XLII. fig. 2), small, slender, spire of two complete revolutions, spines very small and slender, total length 0·015 mm.; of a single spine 0·004 mm.

7. *Metaster*, small, axis short and straight, 0·004 mm. long; spines 0·012 mm. long.

Colour (?).—The sponge is overgrown by some species of Monaxonid, of a black colour, which masks that of the *Sphinctrella*.

Habitat.—St. Iago, Porto Praya, Cape Verde Island, August 1873; depth, 100 to 128 fathoms.

Remarks.—This sponge occurs incrusting a specimen of *Corallistes masoni*; it measures about 25 by 30 mm. in length and about 4 or 5 mm. in thickness; three oscules are present, each from two to three millimetres in diameter, they closely resemble the oscules of the preceding species, but the membrane lining the shallow cloaca presents a comparatively large central aperture. Possibly the sponge is not fully grown and additional apertures may appear with age. The annulated microxea bears a close resemblance to that of *Sphinctrella horrida*, O. Schmidt (*vide* p. 100), with which indeed the present species may prove identical. The presence of this spicule distinguishes the present species

from *Sphinctrella cribrifera*. A thin membrane forms the distal part of the cloacal tube, and through this in a layer but one spicule thick the fringing oxeas (chiefly form No. 2) proceed to the exterior. The membrane is further supported by a thin felt of the annulated microxeas, which are more abundant here than elsewhere. In the choanosome the smooth microxeas chiefly contribute to the felt, though the annulated forms are far from infrequent.

Sphinctrella ornatus, n. sp. (Pl. XLII. figs. 3, 4).

Sponge, incrusting, oscules large, circular, surrounded with a fringe of long oxeas, which lie prostrate over the oscule, completely concealing it; pores (?); surface covered with long prostrate oxeas.

Spicules.—I. Megascleres. 1. *Oxea*, stout, fusiform, usually curved, not sharply pointed, 3·2 by 0·08 mm.

2. *Oxea*, long, slender, cylindrical, sharply pointed; 4·3 mm. by 0·015 mm. This spicule is that which fringes the oscular margin.

3. *Calthrops* (?). It is doubtful whether this spicule is present; out of seven or eight preparations only one or two instances were met with, and these may have been accidentally introduced from specimens of *Sphinctrella gracilis*, which are preserved in the same bottle.

II. Microscleres. 4. *Microtriod* (Pl. XLII. fig. 3), the three actines usually make an angle of 120° with each other, but occasionally two of them are paired, as in the sagittal triradiate of the Calcispongiæ. Sometimes an additional actine is present, and the spicule becomes a microcalthrops; more rarely an actine is suppressed and a diactinate form results, which may be a microxea or not. The most remarkable feature of this spicule is the presence of a ridge-like thickening of the actines, giving to their marginal outline a spined appearance. The ridge winds round the actine spirally or forms a series of transverse rings. It is minutely spined on the summit. In an average example the spire made one complete revolution in a distance of 0·01 mm. measured along the length of the actine, the diameter of the actine being 0·014 mm., and its total length 0·16 mm. In the smallest annulated triod the actines measured 0·06 mm., in the largest 0·2 mm. in length.

5. *Microcalthrops*, the actines are slender, roughened by minute granules and sharply pointed; occasionally a fifth actine is present; the actines measure 0·06 mm. in length.

6. *Spiraster* (Pl. XLII. fig. 4), the spire is concealed by the spines, which are long and numerous, total length 0·0276 mm., of a single spine 0·0118 mm.

7. *Metaster;* this is a very variable spicule, usually of comparatively large size; an amphiastral variety with only four spines at each end measured altogether 0·035 mm. in length; the spines 0·016 mm.; in a genuine metastral form with long slender spines,

pointed or slightly tylote at the extremities, the axis measured only 0·004 mm. in length, the spines 0·02 mm.

Colour.—Greyish-white.

Habitat.—St. Iago, Porto Praya, Cape Verde Islands, August 1873; depth 100 to 128 fathoms.

Remarks.—This sponge occurs incrusting another fragment of the same species of Lithistid (*Corallistes masoni*) as that which furnished the preceding species of *Sphinctrella*. That three different species of the same genus should have been obtained at one time from the same locality may appear somewhat remarkable. There can, however, be little doubt about the fact. The last two species are widely different from each other, notwithstanding the occurrence of an unusual feature in the spicules of both, *i.e.*, the annulation which occurs in the case of the oxea of *Sphinctrella gracilis* and of the triod in *Sphinctrella ornatus*. In the latter species microxeas are absent or only rarely present as modifications of the triods, which with the microcalthrops form the felted skeleton of the sponge; in *Sphinctrella gracilis*, on the contrary, microcalthrops and microtriods do not occur, but are replaced by microxeas, which form the felted skeleton. The annulated microtriods and microcalthrops of the species under description recall the annulate microcalthrops figured by Carter as characteristic of the species *Tisiphonia annulata*, Carter.[1] They are very similar both in size and general appearance, and it would seem probable that Carter's species, which is from the Gulf of Manaar, may be assigned to the genus *Sphinctrella*. Carter also calls attention to the resemblance of the annulated microcalthrops to certain fossil spicules from the Haldon greensand, described by him under the name of *Monilites haldonensis*.[2] There exists no doubt a striking similarity both in size and form between the fossil and the recent spicules, but in the absence of associated spirasters it would be hazardous to do more than point this out.

The cloaca does not appear in *Sphinctrella ornatus* to be separated from the excurrent canals by a special membrane, or if so, the apertures in it are of so large a diameter as to render it inconspicuous.

Genus 4. *Characella*,[3] Sollas.

Theneidæ with spicules like those of *Pœcillastra*, but distinguished by the absence of calthrops from the choanosome.

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vi. p. 494, pl. v. fig. 28, 1880.

[2] *Ann. and Mag. Nat. Hist.*, ser. 4, vol. vii. p. 132, pl. ix. figs. 44, 45, 1871.

[3] χάραξ, ακος ὁ, a pointed stake.

Characella aspera, Sollas (Pl. XL. fig. 6).

Characella aspera and *Normania goliath*, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. pp. 186, 187, 1886.

Sponge (Pl. XL. fig. 6), irregular in form, growing into irregular ridges, lobes, and folds; the furrows between the ridges sometimes prolonged as tubes into the interior. Oscules numerous, the freely open ends of large excurrent canals, situated on the sides and summits of the ridges. Pores numerous, dispersed generally, or collected into circular depressed areas. Surface rough, hispid with projecting oxeas and orthotriænes.

Spicules.—I. Megascleres. 1. *Oxea*, massive, fusiform, usually slightly curved, not sharply pointed; 2·476 by 0·073 mm.

2. *Orthotriæne* (and *dichotriæne*), a conical not sharply pointed rhabdome; cladi simple or bifurcate, projecting outwards and more or less forwards; rhabdome 0·2 to 0·4 by 0·024 to 0·047 mm.; cladi, when simple, 0·2 to 0·63 mm. long; when bifurcate, protocladi 0·143, deuterocladi 0·27 mm. long.

II. Microscleres. 3. *Microxea*, fusiform, straight or curved, sharply pointed, smooth; 0·32 by 0·008 mm.

4. *Amphiaster*, a short fusiform axis, with a whorl of four to six conical sharply pointed spines, and a single spine continuing the direction of the axis at each end; 0·0276 to 0·0434 mm. long; axis about 0·008 mm. long, spines from 0·0118 to 0·0237 mm. long.

5. *Globules*, about 0·048 to 0·16 mm. in diameter, occasionally present.

Colour.—Greyish or yellowish-white.

Habitat.—Station 122, September 10, 1873; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud. Trawled.

Remarks.—Two fragments of this sponge were obtained, the larger about 60 by 80 mm. in breadth and width, and about 25 mm. thick; when complete it must have been thicker as the under surface is broken.

The large oxeas lie irregularly scattered through the sponge; but near the surface many of them are disposed perpendicularly and project beyond it. Horny matter is sometimes found associated with them, as in *Pœcillastra*. The triænes are confined to the exterior and are not numerous there, they lie with the rhabdomes at right angles to the surface, the cladi directed towards it, and either extended beneath or outside it.

The microxeas are thickly dispersed in all directions through the tissues of the sponge, forming a kind of felt; they exhibit a general tendency to lie tangentially to the walls of the canals. They are evidently the homologues of the microxeas of *Pœcillastra*.

The amphiasters are not numerous, they occur beneath the epithelium of the canals, and especially around the margins of the pores. They evidently represent the spirasters of *Pœcillastra*.

The ectosome is only distinguished from the choanosome by the absence of flagellated chambers.

The mesoderm is a finely granular collenchyme, which in the immediate neighbourhood of some of the larger canals becomes clear of granules, cavernous, and traversed by a few fusiform cells. The flagellated chambers are eurypylous, from 0·0276 to 0·031 by 0·039 mm. in diameter. The choanocytes are about 0·004 mm. broad at the base, and 0·006 mm. high, the fenestrated membrane in which their distal ends terminate is more clearly marked than the outer wall of the chamber.

The pores vary from about 0·06 to 0·16 mm. in diameter; the oscules are about 2 to 3 mm. in diameter.

The chief interest in this sponge lies in the rarity of its tetractinellid or triæne spicules, the triænes of the surface are few and easily overlooked; so difficult, indeed, are they to find that at first I was in some doubt as to whether the sponge really possessed them, or belonged to the Tetractinellida at all; some fragments 8 mm. square and 4 mm. thick yielded no triænes when boiled with nitric acid; and it was only by finding them in position in the sponge that I arrived at certain conclusions. They are best found by examining the hispid surface with a powerful simple lens, or by slicing off a part of the superficial layer of the sponge with a razor and examining it *en face*.

The sponge is evidently very nearly allied to *Pœcillastra*; indeed, I feel by no means sure that it differs sufficiently for generic distinction; further discoveries will determine this. By the disappearance of triænes or calthrops from the interior, a certain resemblance to *Stryphnus* is produced, which differs, however, by the presence of true asters, in possessing a cortex, and in the substitution of a sarcenchymatous for a collenchymatous mesoderm.

Genus 5. *Triptolemus*,[1] n. gen.

Thenceidæ in which the characteristic megasclere is a mesotriæne. The microscleres are similar to those of *Normania*, but the microxeas are of hair-like thinness and entirely spined.

Triptolemus cladosus, n. sp. (Pl. XXXV. fig. 23).

Samus quadripartita, MS., Carter.

Sponge.—Small, incrusting.

Spicules.—I. Megascleres. 1. *Oxea* (?).

2. *Mesotriæne* (Pl. XXXV. fig. 23) tetracacladose. Rhabdome with conical similar actines, not sharply pointed; the length of the actines could not be exactly ascertained,

[1] By a singular omission, which I hasten to supply, no one so far as I can ascertain has yet honoured Triptolemus with a genus.

it is probably not much over 0·06 mm. Protocladus 0·052 by 0·021 mm.; deuterocladus 0·036 mm. long; tritocladus 0·0276 mm. long; tetracladus 0·0276 mm. long. The dichotomy of the cladus is not confined to a single plane.

II. Microscleres. 3. *Microxea*, smooth, more or less fusiform; 0·118 by 0·004 mm.

4. *Microxea*, trichose, covered with minute, erect spines; 0·0276 mm. long.

5. *Spiraster*, minute; spines of hair-like fineness; 0·0118 mm. long.

Habitat.—Station 192, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud.

Remarks.—The mesotriænes of this sponge occur isolated in the insoluble residue left after treating with hydrochloric acid a fragment of limestone on which a species of Lithistid is seated. For further information regarding this sponge I am indebted to the kindness of Mr. Carter, who presented me with two slides, labelled *Samus quadripartita*, and bearing mounted fragments of sponge tissue containing the characteristic mesotriænes of *Triptolemus* and the associated microscleres. The spined microxeas form a loose felt similar to that of *Pacillastra*, the mesotriænes lie with the cladi on the whole parallel to the surface of the sponge, and the actines directed at right angles to it. Other spicules occur with those of *Triptolemus*, notably a curious rhabdus or style, bent at the blunt end at right angles like a trenail; this belongs to a sponge named by Carter *Microciona intexta*, var. This is interesting, because a precisely similar spicule occurs along with the mesotriænes of my slides, and it would hence appear probable that Carter's specimens, the habitat of which is unknown, were obtained from near the same locality as those brought home by the Challenger. The dimensions given for the mesotriæne are taken from the largest spicule I could find; in other instances different measurements were obtained, the deuterocladus being sometimes longer than the protocladus—in one instance it measured 0·055 mm., and the latter only 0·035 mm. The dichotomy is not always repeated four times; in many instances the spicule is only tricladose, and it frequently happens that two cladi may be tricladose and the third tetracacladose only on one side, *i.e.*, tetracladi only appear at the ends of two of the tritocladi arising from the same deuterocladus, the tritocladi of the other deuterocladus not branching further.

SUPPLEMENT CONTAINING AN ACCOUNT OF THENEIDÆ NOT IN THE CHALLENGER COLLECTION.

Thenea muricata, Bwk. (Pl. VII. fig. 3).

i. *Tethea muricata*, Bwk., MS.; Phil. Trans., p. 308, pl. xxv. fig. 18, 1858.
ii. „ „ Bwk., MS.; Phil. Trans., pp. 782, 793, 826, pl. xxxi. figs. 14, 15, 1862.
iii. „ „ Bwk., MS.; Brit. Sponges, vol. i. pp. 25, 108, figs. 35, 304, 305, 1864.
iv. *Thenea muricata*, Gray, Proc. Zool. Soc. Lond., p. 541, 1867.
v. *Tethea muricata*, Bowerbank, Proc. Zool. Soc. Lond., p. 131, 1868.
vi. *Tisiphonia*, n. gen., W. Thomson, MS.; Phil. Trans., p. 712, 1869.
vii. *Wyville-Thomsonia Wallichii*, E. P. Wright, Quart. Journ. Micr. Sci., vol. x. p. 7, pl. ii., January 1870.
viii. *Non Stelletta agariciformis* (W. Th.), O. Schmidt, Spong. Atlant. Gebiet., p. 68, May 1870.
ix. *Dorvillia agariciformis*, Kent, Monthly Micr. Journ., p. 293, pl. lxvi., December 1870
x. „ „ Kent, Ann. and Mag. Nat. Hist., ser. 4, vol. vii. p. 37, 1871.
xi. *Thenea Wallichii*, Traquair, Monthly Micr. Journ., vol. iv. p. 293, 1871.
xii. „ „ E. P. Wright, Zool. Rec., 1870 (1872).
xiii. *Tethea muricata*, Bwk., Proc. Zool. Soc. Lond., p. 115, pl. v. figs. 1–6, 1872.
xiv. *Tethya agariciformis*, Kent, Ann. and Mag. Nat. Hist., ser. 4, vol. x. p. 209, 1872.
xv. *Tisiphonia agariciformis*, W. Thomson, The Depths of the Sea, pp. 74, 167, fig. 7, 1873.
xvi. *? Stelletta echinoides*, O. Schmidt, Archiv f. mikrosk. Anat., vol. xiv., 1877.
xvii. *Non Halyphysema echinoides*, Haeckel, Jenaische Zeitschr., vol. xi. p. 16, pl. ii., 1877.
xviii. *Tethea muricata*, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 174, 1878.
xix. *Wyville-Thomsonia agariciformis*, Norman, Journ. Conch., vol. ii. p. 13, 1879.
xx. *Tisiphonia*, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 140, 1880.
xxi. *Tisiphonia agariciformis*, O. Schmidt, Spong. des Meeresbusens v. Mexico, p. 71, 1880.
xxii. *Thenea Wallichii* and *Thenea muricata*, Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. ix. pp. 427–452, pl. xvii., 1882.
xxiii. *Thenea muricata*, Vosmaer, Niederland. Archiv f. Zool., Suppl. Bd. i. p. 5, pl. ii. figs. 1–21, pl. iv. figs. 114, 115, 1882.
xxiv. „ „ and *Thenea Wallichii*, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xi. p. 354–362, 1883.
xxv. „ „ and *Clavellomorpha minima*, n. gen. et sp.; Hansen, Norwegian North Atlant. Exped., p. 18, pl. v. figs. 2 and 6, and pl. vii. fig. 19, 1885.
xxvi. „ „ Vosmaer, Sponges of the "Willem Barents" Exped., p. 4, 1885.
xxvii. *Thenea Wallichii*, Marenzeller, Porifera, &c., from Jan Mayen, p. 6, 1886.

Characters.—These are fully given in my report on Norwegian sponges (xxii.); additional details will be found in Vosmaer's memoirs (xxiii. and xxvi.). The following may be added:—Plesiasters not numerous; collenchyme, excessively developed, granular in the immediate neighbourhood of the flagellated chambers; flagellated chambers small, about 0·035 mm. in diameter.

Distribution.—Vigten Island, Norway (Bwk.). North Atlantic Ocean; lat. 58° 23′ N., long. 48° 50′ W.; depth, 1913 fathoms (E. P. Wright). Kors Fjord, Norway, depth, 200 to 300 fathoms (Norman). Between Anticosti and Gaspé (Whiteaves). Arctic Ocean, from lat. 71° 52′ N., long. 19° 47′ E., to lat. 72° 36′ N., long. 25° 58′ E., depth, 87 to 185 fathoms (Vosmaer). North Sea and Arctic Ocean; lat. 61° 15′ N., long.

6° 36′ E., depth, 650 fathoms, 6°·6 C., clay bottom; lat. 70° 36′ N., long. 32° 35′ E., 127 fathoms, 1°·9 C., clay bottom; lat. 72° 57′ N., long. 14° 32′ E., depth, 447 fathoms, 0°·8 C., clay bottom; lat. 75° 12′ N., long. 3° 2′ E., depth, 1200 fathoms, −1°·6 C., biloculina clay; lat. 72° 53′ N., long. 21° 51′ E., depth, 223 fathoms, 1°·5 C., clay bottom (Hansen). Jan Mayen, 191 to 216 fathoms (Marenzeller). The species, so far as known at present, ranges through the Arctic and North Atlantic Oceans, from about lat. 75° to 50° N., and from long. 32° E. to 60° W., and from 78 to 1913 fathoms in depth.

Remarks.—The history of this sponge, which is a veritable "Comedy of Errors," will be found in the report (xxii.) cited above. The claims of *Thenea* as the rightful generic designation, therein advocated, are now generally recognised. Soon after the appearance of that report,—this is doubtless what is meant by Vosmaer's expression "about the same time,"—Vosmaer independently adopted the genus *Thenea*; but while I had consented to recognise two species, *Thenea wallichii*, Wright, and *Thenea muricata*, Bwk., Vosmaer could only accept one, and that the latter. Later writers (Carter, xxiv.; Marenzeller, xxvii.) recognise two species; Carter after an examination of a large number of specimens. The study of the material brought home by the Challenger, and a renewed examination of Dr. Norman's specimens, which include several obtained by Sir Wyville Thomson in the "Porcupine" expedition, lead me to doubt the correctness of my earlier views; and I am now inclined to admit the identity of *Thenea muricata*, Bwk., and *Thenea wallichii*, Wright. But which of these two specific names should be retained? Bowerbank admits in the fullest manner the insufficiency of his MS. descriptions, for he states that Gray, in suggesting the genus *Thenea*, knew nothing of the sponge on which it was founded beyond illustrations of a "single connective spicule" (Bowerbank, v.). As to this I have reason to believe that Bowerbank was in error. Wright's (vii.) was certainly the first clear and complete description of the sponge; and the identification of *Thenea muricata* with *Thenea wallichii* would not have been possible but for Bowerbank's subsequent publication in full of the characters of the former (Bowerbank, xiii.). This was in my mind when I wrote my paper on *Thenea wallichii*, Wright, and had to choose a name for the sponge of which I was then describing the anatomy.

It will be seen that material still remains for a very pretty controversy on this important question.

The reference to *Stelletta echinoides*, O. Sch. (xvi.), as given by Vosmaer (xxiii.), must I think be erroneous; at all events I am unable to verify it.

Vosmaer definitely assigns *Halyphysema echinoides*, Haeckel (xvii.), to *Thenea muricata*, Bwk. That there is a general resemblance between the former and young examples of the latter cannot be doubted, it has been noticed and commented on by Haeckel himself; but the similarity extends no further, for the asters of *Halyphysema*

echinoides are those of a Geodinid; and if proper to the organism, they prove that it is a young Geodine sponge. I have seen many young *Geodias*, but never one quite like this; there is, however, just so much resemblance as would lead me to conjecture that Haeckel's figure (pl. ii. fig. 128, *loc. cit.*) is a bold but unsuccessful attempt to restore a badly prepared section, were it not that with the figure before my eyes I can scarcely conceive this possible.

In my paper on *Thenea wallichii*, I was not able to say precisely whether the flagellated chambers of that sponge are eurypylous or aphodal. This is remarked upon by Vosmaer (*loc. cit.*, xxvi. p. 5, sep. copy). Considering that Vosmaer, writing subsequently, contributes nothing further to our knowledge of the canal system, beyond the suggestion —which I need not characterise—that the sponge appears to be too full of holes to afford room for flagellated chambers (!), his comments on the intelligibility of my descriptions and the finish of my drawings seem somewhat uncalled for. The illustrations represent in faithful outline—they are *camera lucida* tracings—just what I could see in the sponge and no more; my sections were not perfect enough to enable me to state positively whether the chambers were each provided with an aphodus, or whether they opened several together into a common canal; but I observed the wide mouths by which the communication is effected, and with my present knowledge should have inferred their eurypylous character. At that time I was less familiar with flagellated chambers, but even now, with vastly better prepared slices, I cannot state as a matter of positive observation the exact manner of their communication with the excurrent canals; I infer that they are eurypylous from analogy with *Thenea wyvilli*, but taking into account the excessive development of collenchyme, I should not be greatly surprised to learn that I am mistaken. A section through the ectosome and part of the choanosome of *Thenea muricata* is shown in Pl. VII. fig. 3.

Thenea intermedia, n. sp. (Pl. VII. fig. 4).

Thenea muricata, Bwk. (*pars*), Vosmaer, Spong. "Willem Barents" Exped., p. 5, 1885.

Sponge.—Similar in general characters and composition of the skeleton to *Thenea muricata;* distinguished by larger flagellated chambers, obviously eurypylous, and by comparative deficiency of collenchyme.

Habitat.—Mediterranean.

Remarks.—As the distinction of *Thenea schmidtii* depends on our knowledge of the specific characters of *Thenea muricata*, I prepared fresh slices of Norwegian examples of this sponge, and of specimens from the Mediterranean, which Vosmaer has identified with it. If the characters of the soft parts have that value in classification which I have assigned to them—and this can only be determined after an examination of a large

number of specimens—then the Mediterranean and Arctic species of *Thenea* are distinct. In the latter the canals are reduced to vesicles by very thick walls of collenchyme (Pl. VII. fig. 3), in the former only some of the canals are provided with collenchymatous walls, and the chambers open into wide spaces, the sinuses of folds which in some cases have scarcely yet been converted into tubular canals. The part of the section chosen for illustration (Pl. VII. fig. 4) shows more abundant collenchyme than occurs elsewhere in the same slice. The flagellated chambers vary from about 0·036 by 0·044 mm. to 0·04 by 0·06 mm. in diameter. In the slices of the Mediterranean specimens a thick layer of spirasters, three or four deep, characterises the outer layer of the ectosome; in *Thenea muricata* this is not present.

Pœcillastra compressa (Bowerbank).

Ecionema compressa, Bowerbank, Mon. Brit. Spong., vol. ii. p. 55, 1866; vol. iii. p. 19, pl. ix. figs. 1–12, 1874.

Normania crassa, Bowerbank, Brit. Assoc. Rep., p. 328, 1868; Mon. Brit. Spong., vol. iii. p. 258, pl. lxxxi. figs. 1–12, 1874; vol. iv. p. 29, 1882.

Hymeniacidon placentula, Bowerbank, Mon. Brit. Spong., vol. iii. pp. 189, 353, pl. lxxii., 1874.

Sponge.—Irregularly plate-shaped or cup-like; oscules conspicuous, the patent ends of excurrent canals, irregularly distributed over one face of the sponge, pores evenly dispersed over the other.

Skeleton as in *Pœcillastra schulzii*.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 1·6 to 1·9 by 0·03 to 0·045 mm. 2. *Orthotriæne*, cladi varying from about 0·17 to 0·32 mm. by 0·25 mm.; one or two cladi frequently suppressed. This spicule passes into a calthrops in the interior of the sponge.

II. Microscleres. 3. *Microxea*, 0·14 to 0·2 mm. long. 4. *Plesiaster*, a single actine 0·028 mm. long. 5. *Spiraster*, 0·02 mm. long.

Colour.—Light grey.

Habitat.—Shetland, 110 fathoms; west of Scotland and Hebrides; Queen Charlotte Islands, North America.

Remarks.—Type specimens of Bowerbank's three species were kindly lent me by Dr. Norman, and, after a careful comparison, I can find no difference between them. Mr. Carter's assertion of their identity must therefore be accepted. At first I thought I had discovered a difference in the oscules, but closer examination shows that they have the same characters in all—those, namely, so well portrayed in Bowerbank's figure of *Normania crassa*. Since the specific name "*compressa*" has priority, we have no choice but to adopt it, though it is not very applicable as a descriptive term to all the individuals of the species. The additional locality (Queen Charlotte Islands) rests upon my deter-

mination of a specimen sent me by Mr. Whiteaves, along with other sponges which he obtained there. After a critical comparison of this with Bowerbank's types, I can distinguish no difference of specific value. The spicules agree remarkably well in dimensions, the only difference in this respect being the presence in the American specimen of some very slender forms of oxea, 2·5 by 0·016 mm. in length and breadth, which are absent in the British forms. The occurrence of the same species in such widely separated localities is explicable on the supposition that its distribution is Arctic—an idea which is supported by the fact that it has not been dredged south of latitude 57° N., other species replacing it as we proceed southwards. It probably belongs to the northern group in which *Thenea muricata* and *Craniella cranium* are included.

Pœcillastra scabra (O. Schmidt).

Stelletta scabra, O. Sch., Spong. Adriat. Meeres, Suppl., iii. p. 19, pl. iv. fig. 3, 1868.

Sponge.—A flat cake-like mass, about 20 mm. thick, and as large as a hand; ectosome but slightly developed; canals large and open.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 0·887 mm. long. 2. *Orthotriæne*, rhabdome 0·1775 mm., cladi 0·05 mm. long.

II. Microscleres. 3. *Microxea*, with an irregular nodose or roughened surface, 0·127 mm. long. 4. *Spiraster*, 0·0316 mm. long.

Habitat.—Coast of Algiers.

Remarks.—The dimensions of the spicules were obtained by measurements made from a type-slide in the British Museum collection. I did not succeed in finding any true asters, and as the general facies of the spicules is more that of *Pœcillastra* than *Stelletta*, I with some hesitation refer the sponge to the former genus; it may possibly be more nearly allied to *Characella*. The megascleral oxea is remarkably small, and if the spicules on Schmidt's slide fairly represent those of the sponge, it may be considered as affording a good specific character.

Pœcillastra amygdaloides (Carter).

Pachastrella amygdaloides, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 406, pl. xiv. fig. 22, 1876.

Sponge.—A rounded mass, sessile; surface even, rough; oscule, the patent opening of a shallow cloaca; pores in the interstices among the microxeas. Size, 25 mm. long by 15 mm. broad and 10·5 mm. high.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, sharply pointed, 1·62 by 0·014 mm. 2. *Triod*, actines 0·7 by 0·06 mm. The rudiment of a fourth actine is represented by a short axial fibre, and is sometimes developed into a short strongylate cylindrical process.

II. Microscleres. 3. *Microxea*, 0·115 mm. long; a smaller, centrally-thickened variety of this is also present. 4. *Spiraster*, passing into a metaster, 0·0316 mm. long.

Colour.—Yellowish-white.

Habitat.—Atlantic Ocean, near Cape St. Vincent; depth, 292 fathoms.

Remarks.—Carter calls attention to the resemblance of the spicules of this sponge to those of *Sphinctrella horrida*, O. Schmidt; this suggested to me its relationship to *Pœcillastra*, and, after carefully considering Carter's description, I think it highly probable that it belongs to this genus. The triod appears to represent the cladome of an orthotriæne, the rhabdome of which has been suppressed.

Sphinctrella horrida, O. Schmidt.

Sphinctrella horrida, O. Schmidt, Spong. Atlant. Gebiet., p. 65, pl. vi. figs. 6–7, 1870.

Sponge.—A vertical plate, 2 to 3 cm. thick, with rounded edges; surface rough; oscules, the patent openings of oval elongated cloacas, fringed by a palisade of long spicules; cloacas lined by a fenestrated membrane.

Spicules.—I. Megascleres. 1. *Oxea*, 5·0 by 0·142 mm. 2. *Triæne*, triradiate and quadriradiate; a single actine 1·06 by 0·106 mm.

II. Microscleres. 3. *Microxea*, with an irregularly swollen surface, 0·5 mm. long, and with a smooth surface, 0·18 mm. long. 4. *Spiraster*, 0·022 mm. long.

Colour.—Ectosome blackish, choanosome colourless.

Habitat.—Florida; depth, 111 to 228 fathoms.

Sphinctrella annulata (Carter).

Tisiphonia annulata, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 140, pl. v. fig. 28, 1880.

Sponge.—Massive, 2·12 mm. in diameter, attached.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 0·885 by 0·02 mm. 2. *Calthrops*, actines annulated by transverse, minutely spined, rounded ridges, each actine 0·24 by 0·02 mm.

II. Microsclere. 3. *Spiraster*, 0·0127 mm. long.

Colour.—White.

Habitat.—Gulf of Manaar.

Remarks.—Carter, in recognising the position of this species as one of the Theneidæ, compares the calthrops (2) with the calthrops-like triæne of *Normania crassa* (*Pœcillastra compressa*). But since, as he states, the microxea characteristic of *Pœcillastra* is absent, it cannot be assigned to this genus. Still less can it be assigned to *Thenea* (*Tisiphonia*). The calthrops from its close resemblance to that which occurs in *Sphinctrella ornata* suggests the reference to *Sphinctrella*, to which genus I provisionally assign it.

Characella stellettodes (Carter).

Pachastrella stellettodes, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xv. p. 403, pl. xiv. fig. 14, 1885.

Sponge.—Form (?).

Spicules.—I. Megascleres. 1. *Oxea*, 4·2 mm. long. 2. *Calthrops*, actines 1·15 mm. long.

II. Microscleres. 3. *Microxea*, minutely spined, 0·127 mm. long. 4. *Spiraster* or *Amphiaster*. The oxeas radiate in bundles from a common centre outwards, the calthrops lies in the ectosome, with three actines facial, and the fourth, which is shorter than the others, directed inwards.

Habitat.—Japan, off Misaki, at the entrance to the Bay of Tokio.

Remarks.—The arrangement of the calthrops of this sponge appears to ally it with *Characella*; the radial distribution of the oxeas is not met with in *Characella aspera*; whether it occurs in *Characella agassizi* or not I am uncertain.

Characella agassizi, n. sp.

Pachastrella connectens, var., O. Schmidt, Spong. Meerb. Mexico, p. 68, 1880.

Sponge.—"A large plate-like fragment" (O. Sch.).

Spicules.—I. Megascleres. 1. *Oxea*, stout, fusiform, slightly curved, somewhat anisoactinate, 3·2 by 0·11 mm. 2. *Orthotriæne*, rhabdome and cladi of about the same size, conical, oxeate, from 0·5 to 0·725 mm. in length.

II. Microscleres. 3. *Microxea*, slender, smooth, curved, rarely centrotylote, from 0·225 to 0·55 by 0·005 mm. 4. *Amphiaster*, axis fusiform, produced into a slender spine beyond each terminal whorl of spines, more or fewer of the spines frequently reduced to mere tubercles, but usually long and slender; axis 0·004 mm. long, spines 0·018 mm.; total length of the spicule 0·035 mm.

Habitat.—Grenada, 164 fathoms.

Remarks.—Schmidt gives no information by which this sponge can be identified, and at first I placed it by itself as of unknown genus and species; subsequently, owing to the kindness of Professor Perrier, I had an opportunity of examining a fragment of the original specimen; it has the same general appearance as the sponge which Carter described as *Pachastrella amygdaloides* (*vide Pœcillastra amygdaloides*, p. 99), but since triænes are entirely absent from the choanosome it must be referred to *Characella*; in the general character of its spicules it approaches *Characella aspera*, Sollas.

Triptolemus intextus (Carter).

Pachastrella intexta, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 409, pl. xv. fig. 41, 1876.

Samus (?) intextus, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 60, 1880.

Sponge.—Incrusting on a fragment of *Corallistes bowerbankii*, Johnst.

Spicules.—I. Megascleres. 1. *Oxea* comparatively long (dimensions not ascertained). 2. *Mesotriæne*, actines conical, pointed; cladi dichocladose or trichocladose; 0·186 mm. "in *total* diameter" (Carter).

II. Microscleres. 3. *Microxea* bearing blunt spines of different lengths, 0·021 mm. long. 4. *Amphiaster*, 0·01 mm. long.

Distribution.—Station 25 of the "Porcupine" Expedition; a few miles north of Cape St. Vincent; depth, 374 fathoms.

Triptolemus parasiticus (Carter).

Pachastrella parasitica, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 410, pl. xvi. fig. 50, 1876.

Samus parasiticus, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 60, 1880.

Sponge.—Incrusting (found on a specimen of *Polytrema utriculare*).

Spicules.—I. Megascleres. 1. *Oxea*, 0·38 by 0·016 mm. 2. *Mesotriæne*, rhabdome with conical pointed actines, actines thrice bifurcate, protocladus 0·06 mm. long; deutero- and trito-cladi having together about the same length as the protocladus.

II. Microscleres. 3. *Microxea*, slightly undulating, thickly beset with minute spines, 0·024 mm. long. 4. *Amphiaster*, 0·012 mm. long.

Habitat.—Unknown.

Observation.—The dimensions of the spicules were obtained by direct measurement of Carter's figures, which are drawn to scale.

Genus 6. *Stœba*,[1] n. gen.

Theneidæ in which the skeleton consists of dichotriænes, and spined microxeas like those of *Triptolemus*.

Stœba simplex (Carter).

Samus simplex, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 60, pl. v. fig. 26, 1880.

Sponge.—Excavating.

Spicules.—I. Megasclere. 1. *Dichotriæne*, rhabdome 0·21 by 0·042 mm.

[1] στοιβή, ἡ, a stuffing, filling up.

II. Microsclere. 2. *Microxea*, rod-like, covered with numerous small spines, 0·0127 mm. in length.

Habitat.—Gulf of Manaar.

Genus 7. *Nethea*,[1] n. gen.

Theneidæ, resembling *Pacillastra* in the characters of the spicules, but distinguished by peculiar dichotriænes, with scarcely developed rhabdomes.

Nethea nana (Carter).

Tisiphonia nana, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 138, pl. vii. fig. 43, 1880.

Sponge.—Lamelliform, thin, incrusting or burrowing; surface even.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, curved, 0·38 by 0·014 mm. 2. *Dichotriæne*, rhabdome reduced, represented only by a short, conical, blunt process, 0·085 by 0·042 mm.; chord of cladome 0·7 mm.

II. Microscleres. 3. *Microxea*, fusiform centrotylote, 0·056 mm. long. 4. ? *Spiraster* (a stellate, with a tendency to assume a spinispirulate form, Carter), 0·0125 mm. long.

Colour.—White.

Habitat.—Gulf of Manaar.

Genus 8. *Placinastrella*, F. E. Schulze.

The megascleres are calthrops, triods and oxeas; the calthrops when occurring near the surface is orientated like a triæne, which it then much resembles. The microscleres are of two orders of size, a larger consisting of tri- and di-actinose asters, and a smaller, chiefly confined to the ectosome, and consisting of tetra-, tri- and di-actinose asters.

Placinastrella copiosa, F. E. Schulze.

Plakinastrella copiosa, F. E. Schulze, Zeitschr. f. wiss. Zool., Bd. xxxv. pp. 434, 449, 1880.

Sponge.—Small, a segment of a sphere seated on a flat base, bearing near the summit a single oscular tube. Ectosome excavated by subdermal cavities, and traversed by numerous minute asters and microxeas, the latter near the surface being directed at right angles to it, and thus minutely hispidating it.

Spicules.—I. Megascleres. 1. *Calthrops* with four equal actines in the choanosome, near the surface, triæne-like, the longest actine 0·142 mm. long. 2. This passes into triods and oxeas.

[1] The name *Nethea* is an anagram of *Thenea*, itself a fortuitous combination of letters.

II. Microscleres. 3. Large *oxyasters* with three or two actines. 4. Small *oxyasters* with four, three, or two actines.

Colour.—Clear yellowish. Size, 20 mm. in basal diameter, 5 mm. high.

Habitat.—Naples.

Family II. Pachastrellidæ.

Streptastrosa in which the chief megascleres are calthrops; triænes being absent. The microscleres may be spirasters, spherasters, or microrabds.

The choanosomal mesoderm is sarcenchymatous, and the chamber system aphodal.

Genus 1. *Pachastrella*, O. Schmidt.

Pachastrellidæ in which the megascleres are calthrops and oxeas; the microscleres spirasters and microstrongyles.

Pachastrella abyssi, O. Schmidt (Pl. XI.; Pl. X. fig. 15).

Pachastrella abyssi, O. Schmidt, Spong. Atlant. Gebiet., p. 64, pl. vi. fig. 4, 1870; Spong. Meerb. Mexico, p. 68, 1880.
" " Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. pp. 405, 407, 410; 1876.

Sponge (Pl. XI. fig. 1).—Massive, free, an irregular, horizontally extending, plate-like mass, irregularly thickened, with rounded edges; osculiferous surface somewhat depressed below the general margin, incrusted with foreign matter; poriferous surface irregularly convex, free from incrusting material; oscules small, numerous, simple, opening at the level of the surface, not sphinctrate; confined to one side of the plate; pores simple, confined to the side of the plate opposite to that bearing the oscules.

The excurrent canals, which are wider than the oscules, descend perpendicularly into the sponge, and repeatedly branching in their course, extend up to the poriferous surface; nearly as far as which they are traceable by the unaided eye. The incurrent canals are smaller, more numerous, and not traceable without the aid of a lens.

The ectosome is from 1·0 to 1·5 mm. thick, and consists of collenchyma, including abundant granule-clusters. The choanosomal mesoderm is a sarcenchyme approaching a granular collenchyma.

The flagellated chambers are somewhat large, about 0·0355 mm. wide, and 0·0237 mm. long; both the apopyle and prosopyle are usually wide, often 0·0158 mm. in diameter.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XI. fig. 2), slender, cylindrical, sharply pointed, curved or undulating, 2·54 by 0·016 mm.

2. *Calthrops* (Pl. XI. figs. 3, 4); actines conical, sharply pointed, usually simple, occasionally dichotomous, sometimes irregularly branched, bent and tubercular (Pl. XI. figs. 15–19); a single actine, 0·796 by 0·0636 mm.

II. Microscleres. 3. *Centrotylote microxea*, slender, sharply pointed, surface roughened, 0·083 mm. long. These spicules are precisely similar to the corresponding ones of *Pœcillastra*; they occur sparingly and locally, and may possibly have been derived from a species of *Pœcillastra* (*Pœcillastra incrustans*) which incrusts the poriferous surface.

4. *Microstrongyle* (Pl. XI. figs. 11–13), of variable form, sometimes prolately ellipsoidal, sometimes cylindrical, with rounded ends, and sometimes centrotylote, then navicula-like in outline, surface usually smooth, sometimes roughened; from 0·014 by 0·0046 mm. to 0·01 by 0·0052 mm. This spicule has probably been derived from a diactinose oxyaster.

5. *Spiraster* (Pl. XI. figs. 9, 10), of variable character, sometimes a true spiraster, more often a metaster or amphiaster; axis or spire slender, spines numerous, very slender; 0·0118 to 0·0158 mm. long; a single spine may attain a length of 0·006 mm.

Colour.—Cream-yellow.

Habitat.—Station 135c, Tristan da Cunha, October 17, 1873; lat. 37° 25′ 30″ S., long. 12° 28′ 30″ W.; depth, 110 fathoms; bottom, hard ground, shells and gravel.

Florida, 228 fathoms (O. Schmidt, *loc. cit.*, p. 64), and various places in the Gulf of Mexico (O. Schmidt, *loc. cit.*, p. 68). Near Cape St. Vincent, 292 fathoms, "Porcupine" Expedition, Station 24 (Carter, *loc. cit.*, p. 407).

Remarks.—Two specimens of this sponge were obtained; one is entire, the other subdivided into six pieces and not quite complete. The perfect specimen is that represented in the plate. It is 78 mm. wide, 150 mm. long, and 25 mm. in average thickness. The pieces of the other specimen when put together form a mass 200 by 150 mm. in length and breadth, and 90 mm. in maximum thickness.

The oscular surface in both specimens is incrusted by blue sand and various attached foreign bodies and organisms. The oscules are about 1 to 1·5 mm. in diameter. The poriferous surface, otherwise bare, is overgrown over a considerable area by a species of *Pœcillastra* (*Pœcillastra incrustans*), the canals of which, passing vertically through its plate-like growth, terminate immediately over the poriferous ends of the incurrent canals of the *Pachastrella* (Pl. X. fig. 15). The ectosome consists of collenchyma which is crowded with oval, not very deeply stained, cells, from 0·016 to 0·02 mm. in diameter; they consist of spherical granules, about 0·004 mm. in diameter, which lie close together, concealing the nucleus if it be present. Each granule-cell lies in a distinct cavity in the collenchyme, which consists of a clear, colourless matrix and not very easily discerned

collencytes. This tissue extends from the ectosome inwards, forming a wall to the larger incurrent and excurrent canals. Near the free surface of the canal walls or of the ectosome the granule-cells are crowded closely together in cavities only just large enough for them; but further inwards they are separated by wider intervals, and the cavities in which they lie are sometimes several times the diameter of the cells themselves both in length and width (Pl. XI. fig. 27). The walls of these cavities are usually very thin, mere immeasurable films, in which, however, collencytes can be discerned under favourable conditions. The granule-cells in some parts of the tissue lose their granules, and are reduced to a finely granular protoplasm, in which a nucleus and nucleolus are to be seen (Pl. XI. fig. 26). In some cases these cells take a far fainter stain than usual, while the surrounding matrix becomes stained, so that, instead of appearing as darkly coloured cells on a colourless ground, they are seen as pale cells on a darker ground (Pl. XI. fig. 25).

The mesoderm of the choanosome does not take a very deep stain; more gelatinous matrix appears to be present than is usual in sarcenchyme, and it might perhaps be more properly termed a highly granular collenchyme.

The Skeleton.—The oxeate rhabdi are collected together into bundles which run more or less parallel to the sides of the larger canals, and at right angles to the external surface of the sponge; the tissue surrounding them is not modified to form a spicular tract. The calthrops appear, for the most part, to be scattered through the sponge without any arrangement, they are densely crowded together, their actines crossing each other in all directions. Near the exterior of the sponge, however, two or three of the actines tend to lie tangentially with the surface, and a similar disposition is to be observed in those calthrops which lie adjacent to the walls of the canals. Near the bundles of oxeas also the calthrops show a tendency to definite arrangement, three of the actines extending more or less at right angles to the course of the bundles, and the fourth parallel to it; in this case the calthrops is orientated in the same manner as a triæne would be in a corresponding position.

The microstrongyles form a dense layer immediately beneath the outer epithelium (Pl. XI. fig. 25), and occur in a single layer beneath the epithelium of the canal walls, they are also irregularly scattered throughout the tissues of the sponge generally. The spirasters appear to be restricted to a position immediately beneath the lining epithelium of the canals, occurring in conjunction with the microstrongyles, or occasionally by themselves, in the latter case usually only in the vela of the canals, or in the smaller canals of the choanosome.

In the earliest observed stage of the calthrops (Pl. XI. fig. 4) its actines are traversed by disproportionately large axial fibres, which are probably continued into the substance of the surrounding scleroblast, since in nitric acid preparations the axial canals are freely open at the extremities of the actines.

Irregularities in the form of the calthrops are not uncommon (Pl. XI. figs. 15–23); the actines may branch, often more or less irregularly, the branches becoming crooked and tubercular towards their termination (Pl. XI. figs. 17–19), and then suggesting a resemblance to the tetracrepid desma of the Lithistida; in other cases the actines may be reduced (Pl. XI. figs. 21–23) to three or even two in number.

The canals of the sponge are crossed by velar diaphragms, and the aphodal canals of the flagellated chambers (Pl. XI. figs. 28–31) are frequently alternately constricted and enlarged as though by minute vela.

Genus 2. *Calthropella*, n. gen.

Pachastrellidæ with only one form of microsclere, which is a euaster.

Calthropella simplex, n. sp. (Pl. X. figs. 13, 14, and 21–29).

Sponge (Pl. X. figs. 13, 14).—Massive, irregularly ridge-like, with a flattened base and rounded sides. Surface smooth, raised in places into small rounded tubercles, each with a crater-like depression at the summit, from 0·15 to 0·5 mm. in diameter, and a centrally perforated floor. Oscules and pores similar, the central perforation of the tubercles leading into comparatively large, underlying cavities, from which numerous canals descend into the choanosome.

Spicules.—I. Megascleres. 1. *Calthrops* of the first order (Pl. X. figs. 21–27); actines conical, smooth, simple, oxeate, tornote, or strongylate, 0·8 by 0·09 mm. The actines are frequently reduced to three in number, sometimes to one, occasionally they are more numerous than four; a tendency to a tubercular growth sometimes occurs (Pl. X. fig. 27). 2. *Calthrops* of the second order, similar to the foregoing, but smaller, actines 0·15 by 0·02 mm.

II. Microscleres. 3. *Spheraster* (Pl. X. fig. 28), centrum comparatively large; actines numerous, reduced to rounded tubercles, 0·0237 mm. in diameter. A smaller form, 0·012 mm. in diameter, bearing fewer tubercles, is present beneath the outer epithelium. In the young state the actines are slender, conical, and oxeate (Pl. X. fig. 29).

Colour.—Opaque-cream, or ochreous-white.

Habitat.—St. Iago, Porto Praya.

Remarks.—This sponge, which is not quite complete, measures in its present state 90 mm. in length, it is 45 mm. broad at the base, and 38 mm. high.

The ectosome consists of collenchyme containing numerous, deeply-stained, granule-cells, about 0·016 to 0·02 mm. in diameter, and elongated, fusiform cells, which are disposed tangentially, and render it fibrous. Its thickness is variable, in places as much

as 0·2 mm. Beneath the outer epithelium is a layer of spherasters, chiefly of the smaller size already described, though the larger forms are freely mingled with them.

The choanosomal mesoderm is a darkly staining sarcenchyma; numerous granule-cells are scattered through it.

The canals are traversed by numerous velar diaphragms, the central aperture of which is surrounded by concentrically arranged myocytes; while fusiform collencytes radiate inwards from the margin. The flagellated chambers measure about 0·02 mm. in breadth and 0·016 mm. in length. The apopyle is usually wide, 0·0118 mm. in diameter.

The sponge is very nearly related to *Calthropella* (*Pachastrella*) *geodiides*, Carter, which differs from it in the character of the calthrops: in the latter species these are provided with dichocladose actines.

Supplemental Account of all other known Species of Pachastrellidæ not in the Challenger Collection.

Genus *Dercitus*, Gray.

Dercitus, Gray, Proc. Zool. Soc. Lond., p. 542, 1867.
Pachastrella, O. Schmidt, Spong. Atlant. Gebiet., p. 76, 1870.
Battersbyia, Bowerbank, Mon. Brit. Spong., vol. iii. p. 347, 1874.

Pachastrellidæ in which the microscleres are spined microrabds and toxas.

Dercitus bucklandi (Bowerbank).

Halina bucklandi, Bowerbank, List Brit. Marine Invert. (Brit. Assoc.), p. 70, 1861.
Hymeniacidon bucklandi, Bowerbank, Mon. Brit. Spong., vol. ii. p. 226, 1866; vol. iii., pl. xxxviii. figs. 9–12, 1874.
Dercitus bucklandi, Gray, Proc. Zool. Soc. Lond., p. 542, 1867.
Pachastrella bucklandi, O. Schmidt, Spong. Atlant. Gebiet., p. 76, 1870.
Dercitus niger, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. vii. p. 13, pl. iv. figs. 1–6, 1871.
Battersbyia bucklandi, Bowerbank, Mon. Brit. Spong., vol. iii. p. 346, pl. xcii. fig. 8, 1874.
Dercitus bucklandi, Norman, Mon. Brit. Spong., vol. iv. p. 93, 1882.

Sponge.—Massive, sessile. Surface minutely hispid, even. Oscules simple, dispersed. Pores inconspicuous.

Spicules.—I. Megasclere. 1. *Calthrops*, actines simple, conical, smooth, oxeate, 0·32 by 0·045 mm.

II. Microscleres. 2. *Toxa*, 0·09 by 0·003 mm. 3. *Spinose microrabd*, 0·0276 by 0·008 mm., including the spines.

Colour.—When alive dark purple externally, light brown within. Size various, up to 50 mm. long by 25 mm. broad, and 25 mm. thick.

Habitat.—Torquay; Guernsey, at extreme low water (Bowerbank); Budleigh, Salterton, Devon (Carter); Westport Bay (Norman).

Remarks.—The ectosome is not more than 0·5 mm. thick; in dried specimens I saw no appearance of fibrous tissue in it, it seems to consist of collenchyme, crowded with calthrops and pigmented granule-cells. The spinose microrabds are, when young, frequently even up to a length of 0·02 mm., smooth centrotylote microxeas, obviously diactinose asters. When sparsely spined they call to mind the microxeas of *Ecionema bacillifera*, Carter. They are generally scattered through the sponge, and form a thin layer beneath the outer epithelium. The presence of the toxa is somewhat surprising, and Schmidt remarks that such spicules, characteristic as they are of the Desmacidine series, have, without any doubt, been merely accidentally introduced into the preparation (*loc. cit., supra*). This, however, is certainly not the case; the toxas are as much parts of the sponge as any of the other spicules. It is not probable that any of the Pachastrellidæ have points of contact with the Desmacidina, and one would naturally look to ancestral forms such as *Pœcillastra* or *Pachastrella* for the homologue of this spicule. The microrabds can very well be explained as representing the microstrongyles of the latter or the microxeas of the former; but the toxas, judging from analogy, are more likely to be traceable to a spiral than to an actinal form. The only spiral form in either *Pœcillastra* or *Pachastrella* is the spiraster, and in the absence of intermediate links, and considering the vast difference in size, it seems hazardous to suggest that this can have been the parent of the *Dercitus* toxa. In *Caminus apiarium*, O. Schmidt, remarkable toxa-like spicules occur, evidently explicable as diactinose forms of an aster, but the toxas of *Dercitus* are not to be explained in this way; they are more probably microxeas which have acquired a curvilinear growth.

Norman in discussing the nomenclature of this sponge rightly claims priority for *Dercitus* over *Pachastrella*, but adds that undoubtedly Schmidt's genus *Pachastrella* is identical with *Dercitus*, in this agreeing with Schmidt himself and Carter. It appears to me, however, that the differences between them are as great as in some other groups would serve to distinguish subfamilies. It is true that similar differences in different groups are of unequal value, but this is not always so. The only case in which it can be certainly alleged is when the differences are inconstant; when they are constant but serve to divide a family into a number of genera, each containing a single species only, one cannot assert that they are of unequal value as compared to similar differences which in another family give us genera each with several species. The more natural explanation might then appear to be that a family with genera of single species is one which by severe exposure to unfavourable conditions has become impoverished. Such an explanation may possibly be true for the Pachastrellidæ, the different genera of which are separated by characters which in the Stellettidæ are of subfamily importance.

Pachastrella monilifer, O. Schmidt.

Pachastrella monilifer, O. Schmidt, Spong. Algiers, p. 15, pl. iii. fig. 7, 1868.

Sponge.—An irregular nodular fragment with a rough surface; oscules several, from 0·5 to 1·0 mm. in diameter.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, almost cylindrical, slender; broken specimens measure 0·03 mm. in diameter and up to 1·75 mm. in length, but when perfect they may have been as much as twice as long. 2. *Calthrops*; the young forms, up to a stage in which the actines measure 0·2 mm. in length, are regular and isoactinate, but when fully grown they resemble a triæne in the fact that three of the actines are regularly curved forwards like the cladi of a large protriæne, while the fourth is straight and longer than the others, resembling the rhabdome of a triæne; the spicule then presents a remarkable similarity to the protriæne of *Stryphnus rudis* (*vide postea*). The curved actines attain a length of 0·835 mm., the straight actine measures 1·03 by 0·095 mm. In an example in which the curved actines are 0·8 mm. long the chord measures 0·825 mm.

II. Microscleres. 3. *Microxea*, fusiform, curved, 0·35 mm. in length. 4. *Microstrongyle*, centrotylote, 0·02 by 0·004 mm. 5. *Amphiaster*, the axis continued into a spine beyond the whorls at each end, spines and axis remarkably slender, total length 0·0118 mm.

Habitat.—Coast of Algiers.

Remarks.—This species is the type of the genus *Pachastrella* as instituted by Schmidt. I at first provisionally separated *Pachastrella abyssi* from it as the type of a new genus, *Picraster*, on the assumption that Schmidt's description could be depended upon. Subsequently I received through the kindness of Professor Perrier a fragment taken from Schmidt's type, and to my surprise I find that it is scarcely specifically different from *Pachastrella abyssi*. Neither in this specimen nor in a type slide of spicules presented by Schmidt to the British Museum are any of the concentrically striated umbilicated discs described and figured by Schmidt as occurring in *Pachastrella monilifer* to be found, while the amphiaster, which Schmidt may be supposed to have regarded as absent, for he does not mention it, is abundant enough in the specimen I received from Professor Perrier, though not in Schmidt's preparation in the British Museum collection. The microxeas are sometimes not only bent in the middle but slightly reflexed at each end, in a manner which suggests the idea that the toxa of *Dercitus* may have been derived from similar spicules.

Calthropella geodiides (Carter).

Pachastrella geodioides, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 407, pl. xiv. fig. 23, 1876.

Sponge.—More or less spherical, wider at the base than at the summit; surface even, slightly roughened by projecting spicules; oscules small, scattered singly.

Spicules.—I. Megascleres. 1. *Oxea*, 0·736 by 0·0093 mm. 2. *Calthrops*, three actines of equal length, 0·7 by 0·085 mm., the fourth reduced to a rounded tubercle, or suppressed, being represented merely by a short axial fibre within a triactinate form. 3. *Dichocalthrops*, variable, one actine simple, suppressed or not, the other three bifurcated or not. Smaller than the simple calthrops.

II. Microsclere. 4. *Spheraster*, centrum large, actines reduced to rounded tubercles; 0·0254 mm. in diameter.

Colour.—Dark grey. Size, 25 mm. high, by 25 mm. in diameter at the base.

Habitat.—Near Cape St. Vincent.

Calthropella (?) *exostitus* (O. Schmidt).

Pachastrella exostitus, O. Schmidt, Spong. Algiers, p. 16, pl. iii. fig. 12, 1868.

Spicules.—I. Megasclere. 1. *Calthrops.*

II. Microscleres. 2. *Tuberculate microrabds* and *spherasters.*

Habitat.—Red Sea.

Remarks.—The spheraster with actines reduced to tubercles appears to resemble that of *Calthropella geodiides* and *Calthropella simplex*, and I therefore with some hesitation assign this species to the genus *Calthropella*. The tuberculated microrabd suggests affinities to *Dercitus*.

Genus (?).

Pachastrella connectens, O. Schmidt, Spong. Atlant. Gebiet., p. 65, pl. vi. fig. 5.

Sponge.—"A smutty brown knob."

Spicules.—I. Megascleres. 1. *Oxea*, 2·13 mm. long. 2. *Calthrops*, actines 0·71 by 0·305 mm.

II. Microscleres. 3. *Microxea*, 0·1 mm. in length. 4. *Microstrongyle*, often centrotylote, 0·19 mm. long. 5. *Aster*, 0·035 mm. in diameter.

Habitat.—Florida, 7½ fathoms.

Remarks.—I have pieced together the information afforded by Schmidt's description and a type-slide in the British Museum, but with no satisfactory result.

Genus (?).

Pachastrella lithistina, O. Schmidt, Spong. Meerb. Mexico, p. 68, pl. ix. figs. 3, 4, 1880.

Sponge.—In plates 15 to 20 mm. thick, the upper surface produced into many flat humps, each bearing a single oscule, 0·5 mm. in diameter; the under surface with similar oscules or pores. These openings lead into a labyrinth below the outer layer of the cortex, penetrating the whole thickness of the plate.

Spicules.—I. Megasclere. 1. *Calthrops.*

II. Microscleres. 2. *Microstrongyle*, growing out in irregular processes, finely tuberculated, 0·008 mm. long. 3. *Asters*, 0·008 to 0·01 mm. in diameter.

Species originally described as Pachastrellidæ which are here referred to other Families.

Pachastrella intexta, Carter = *Triptolemus intextus* (see p. 102).
Pachastrella parasiticus, Carter = *Triptolemus parasiticus* (see p. 102).
Pachastrella amygdaloides, Carter = *Pacillastra amygdaloides* (see p. 99).
Pachastrella connectens, var., O. Sch. = *Characella agassizi* (see p. 101).

Demus II. Euastrosa.

Astrophora in which euasters are always present, but never spirasters nor sterrasters. Triænes are present but not calthrops.

Family I. Stellettidæ.

Euastrosa in which the megascleres are oxeas, and orthotriænes, or plagiotriænes, or dichotriænes and frequently in addition anatriænes. The chamber system is aphodal and the mesoderm of the choanosome sarcenchymatous.

Subfamily 1. Homasterina.

Stellettidæ, which never possess more than one form of aster.

Genus 1. *Myriastra*, Sollas.

Sponge small; oscules distinct; pores in sieves, leading into subdermal cavities. Ectosome thin, collenchymatous, excavated by widely extending subdermal cavities. The single form of microsclere is a chiaster.

Myriastra subtilis, Sollas (Pl. XIV. figs. 23–28).

Myriastra subtilis, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 188, 1886.

Sponge (Pl. XIV. fig. 23).—Small, cylindrical, compressed, rounded above, produced into a few short rounded lobes below; at the summit a few small oscules of different sizes, each leading into a deep cloacal tube, which receives several small excurrent canals. Pores in sieves, generally distributed over the surface.

Flagellated chambers from 0·02 to 0·036 mm. in diameter, with an apopyle from 0·0118 to 0·016 mm. in diameter; aphodus short, about 0·016 mm. long, and of the same diameter as the apopyle; sometimes absent, when the chamber becomes eurypylous.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XIV. fig. 24), fusiform, straight or slightly curved, ends variable, sharply or bluntly pointed, or rounded off, or somewhat mucronate, like a lead-pencil point; 1·33 to 1·51 by 0·0316 mm.

2. *Dichotriæne* (Pl. XIV. fig. 25), with a straight conical rhabdome, pointed variably like the oxea, and bifurcated cladi, the protocladi projecting forwards, the deuterocladi extending horizontally. Rhabdome 1·16 to 1·33 by 0·04 mm., protocladi 0·16 mm., deuterocladi 0·0413 mm. long; chord 0·4 mm.

3. *Anatriæne* (Pl. XIV. fig. 26), with a straight, cylindrical, sharply pointed rhabdome, and short, curved, sharply pointed cladi; distal outline of the cladome nearly semicircular. Rhabdome 1·16 by 0·012 mm., cladi 0·04 mm. long, chord 0·06 mm.

II. Microsclere. 4. *Chiaster* (Pl. XIV. figs. 27, 28), actines tylote, variable in number, frequently very numerous, rarely reduced to three or four; from 0·008 to 0·01 mm. in diameter; when reduced to a triradiate form, each actine 0·008 mm. in length.

Colour.—Greyish-white.

Habitat.—Kobé, Japan; depth, 8 to 50 fathoms.

Remarks.—Two specimens of this sponge are in the collection; one fragmentary, and the other complete, the latter is 15 mm. high, 10 mm. and 11 mm. in breadth and width. At the summit are three oscules, the largest 1 mm. in diameter. The ectosome varies from about 0·18 to 0·32 mm. in thickness; it consists of collenchyme, which immediately below the outer epithelium passes in some places into a layer of darkly stained tissue containing numerous minute oval vesicles, about 0·006 mm. in diameter, each containing an oval protoplasmic mass; these cells become more densely crowded together as they are traced towards the exterior; elsewhere this tissue is replaced by a layer of fusiform cells, probable myocytes. In the midst of the ectosome occur small cell-like aggregates, about 0·012 mm. in diameter, consisting of minute homogeneous, spherical, deeply stained bodies, about 0·003 mm. in diameter; these aggregates, the nature of which is problematical, occur in considerable numbers,

frequently collected together into clusters, and though most conspicuous in the ectosome, are not confined to it, but extend generally throughout the sponge.

The subdermal cavities communicate with the exterior by short, dome-like, upward extensions, which, penetrating the roof, open in the pores. The sarcenchyme of the choanosome extends up to the epithelium of most of the canals; but the main excurrent canals are surrounded by collenchyme, which forms a strong partition between them, where they approach each other about the axis of the sponge. The collenchyme in this position is rendered highly fibrous by numerous fibrillated fusiform cells irregularly distributed through it. The main incurrent canals are crossed by vela.

The flagellated chambers communicate with the excurrent canals by short wide aphodi, which are sometimes absent, the chambers then becoming eurypylous.

A complete passage can be traced from the young triænes with simple cladi, which lie in the choanosome, up to the adult forms with bifurcate cladi, which extend beneath the outer epithelium. The chiasters are most numerous in the ectosome, and in the walls of the larger excurrent canals; in the neighbourhood of the flagellated chambers they are rare.

Myriastra simplicifurca, Sollas (Pl. XII. figs. 29–33).

Myriaster simplicifurca, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 189, 1886.

Sponge (Pl. XII. fig. 29).—Small, rounded, compressed, cylindrical, produced into lobes below; one small oscule on the upper surface,[1] pores in sieves generally distributed.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XII. fig. 30), fusiform, straight or curved slightly, usually sharply pointed, 2·0 by 0·0316 mm.

2. *Orthotriæne* (Pl. XII. fig. 31), a straight conical rhabdome attenuated to an exceedingly sharp point, and with three simple cladi springing forwards at an angle of about 45° with the produced axis of the rhabdome, and then extending horizontally; rhabdome 2·325 by 0·055 mm., cladi 0·366 by 0·054.

3. *Anatriæne* (Pl. XII. fig. 32), a straight, slender, cylindrical, usually very sharply pointed rhabdome, and curved, conical, sharply pointed cladi, which proceed from the rhabdome almost at right angles for about half their length, and then curve backwards till nearly parallel with it. The front of the cladome is thus usually flattened, though sometimes rounded; rhabdome 1·86 by 0·0296 mm., cladi 0·12 mm. long, chord 0·127 mm.

II. Microscleres. 4. *Chiaster* (Pl. XII. fig. 33), actines tylote, 0·012 mm. in diameter.

Colour.—Yellowish-white.

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; bottom, coral mud.

[1] The sponge as represented in the plate is inverted.

Remarks.—But one specimen of this sponge is in the collection; it measures 11 by 7 mm. along two horizontal diameters, and 14 mm. in height. The single oscule at the summit is 0·8 mm. in diameter. The ectosome, which is about 0·32 to 0·4 mm. in thickness, consists of collenchyme, with a layer of fusiform cells (myocytes) beneath the outer epithelium, and beneath the myocytes numerous dispersed vesicular cells. They are oval in outline, 0·011 by 0·014 mm. in diameter, with colourless, not stained, sharply defined walls, a spherical nucleus, about 0·0026 mm. in diameter, also not stained, and colourless, or with only a slightly bluish tinge; radiating protoplasmic strands, or a protoplasmic network, of similar optical characters, surround the nucleus, and connect it with the wall of the vesicle.

Abundantly scattered through the ectosome, and generally present throughout the sponge, are oval clusters of what appear to be minute protophytes, each an elongated, ellipsoidal, or rounded cylindrical cell, about 0·0035 mm. in diameter and 0·0075 mm. in length. Nothing could be made out of the contents, which appear to be homogeneous and structureless, and though the shining appearance of the cell, due to the difference of its refractive index to that of the cellular elements of the sponge, led one to imagine the presence of a cellulose envelope, yet the application of Schulze's solution yielded no cellulose reaction. With iodine no indication of starch was obtained.

Choanosome.—The flagellated chambers vary from about 0·0276 to 0·035 mm. in breadth, and are usually about 0·0237 mm. long. The prosopyle varies from about 0·008 to 0·0158 mm. in diameter, and the apopyle from 0·012 to 0·027 mm. The choanocytes present a rounded, almost spherical base, about 0·003 in diameter, produced into a collum of about 0·004 mm. in length; from this a tubular collar, 0·008 in length, extends up to the fenestrated membrane of the chamber, into which it passes; the total length of the choanocyte, when extended, is thus about 0·015 mm.; when contracted, it is barely half of this, viz., 0·006 mm.

The spicules are many of them still invested in their scleroblasts, and afford excellent opportunities for determining the relative position of the scleroblastic nucleus; in the case of the oxeas two measurements were obtained, in one the nucleus was seated exactly midway between the two ends of the spicule, in the other it was found to be 0·197 mm. distant from one end and 0·257 mm. from the other; for the anatriænes also two measurements were obtained, in one the nucleus was found on the rhabdome, 0·71 mm. from the proximal end and 0·395 mm. from the cladome, in the other 1·065 mm. from the proximal end and 0·395 mm. from the cladome; in the case of the single orthotriæne, the nucleus was found to lie 0·257 mm. from the proximal end and 0·079 mm. from the cladome. If we regard the nucleus of the scleroblast as the morphological centre of the spicule, these results show that the cladome of the triænes is equivalent to or represents from one-third to one-half of the length of the rhabdome. The size of the scleroblastic nucleus, which is oval in outline, is about 0·02 mm. along one diameter,

and 0·012 mm. along the other; the spherical nucleolus is about 0·0039 mm. in diameter.

Myriastra clavosa (Ridley) (Pl. XII. figs. 34–43).

Stelletta clavosa, Ridley, Rep. Zool. Coll. "Alert," 1881–82, p. 474, pl. xliii. figs. 1, 2.

Sponge (Pl. XII. fig. 34).—Small, spherical, free; flattened or depressed above, in the centre of the depression a single small, circular, or oval oscule, with a thin membranous margin, which roofs over the cloacal chamber, into which numerous small excurrent canals open. Surface even; pores uniformly distributed in sieve-like areas.

Flagellated chambers small, on an average 0·02 mm. in diameter.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XII. fig. 35) slender, fusiform, straight or slightly curved, sharply pointed; from 2·86 by 0·016 mm. to 3·42 by 0·0316 mm. in diameter.

2. *Dichotriæne* (Pl. XII. fig. 36), a slender, conical, usually excessively sharply pointed rhabdome; protocladi projecting forwards and outwards, deuterocladi extending horizontally. Rhabdome from 2·825 by 0·035 mm. to 3·42 by 0·047 mm.; protocladi from 0·08 to 0·11 mm. long; deuterocladi from 0·27 to 0·29 mm. long.

3. *Anatriæne* (Pl. XII. fig. 37), a long, slender, sharply pointed rhabdome, cladi conical, regularly recurved, sharply pointed; front of the cladome usually rounded hemispherically. Rhabdome 2·32 by 0·002 mm. to 3·02 by 0·024 mm.; cladi from 0·055 to 0·079 mm. long, chord and sagitta from 0·04 and 0·08 to 0·072 and 0·127 mm.

4. *Cloacal oxea*, slender, fusiform, sharply pointed, 0·318 by 0·009 mm.

II. Microsclere. 5. *Chiaster* (Pl. XII. fig. 38), actines tylote, 0·008 to 0·012 mm.

Colour.—Faint yellowish or greenish-white.

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 6 fathoms; bottom, coral mud. Dredged.

Station 208, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; depth, 18 fathoms; bottom, blue mud. Trawled.

Also (Ridley), Prince of Wales Channel, and West Island, Torres Straits, 7 to 9 fathoms; bottom, sand and coral; and Arafura Sea, off north-west coast of Australia, 32 to 36 fathoms; bottom, sand, mud, and shells.

Remarks.—The collection contains a series of specimens all remarkably alike in form, structure, and the characters of their spicules; and it has been a task of great difficulty, attended with considerable uncertainty, to define the exact limits of the species. Ridley states that the spicules of the numerous specimens which he examined varied but slightly in dimensions; of those which I have regarded as belonging to *Myriastra clavosa*, this, as will be seen from the appended table, can hardly be said; they differ in

dimensions among themselves and from Ridley's type. The anatriænes are all longer than in Ridley's specimens, and were it not that they form a graduated series I should be disposed to eliminate the specimen from Station 208, and make a distinct variety of it. The cladomes of the anatriænes also differ somewhat in form as well as size, in some the length of the sagitta being less and in others more than half the length of the chord.

	Oxea.	Dichotriæne.	Anatriæne.	Cladome of the Anatriæne.		
				Length of Cladi.	Sagitta.	Chord.
Station 186 (i.), . .	2·86 by 0·016	2·825 by 0·035	2·65 by 0·02	0·055	0·04	0·08
„ „ (ii.), . .	2·55 by 0·02	3·034 by 0·03	2·32 by 0·02	0·071	0·055	0·096
„ „ (iii.), . .	3·42 by 0·0316	3·42 by 0·047	2·67 by 0·0175	0·079	0·072	0·127
„ 208, . . .	2·79 by 0·024	3·02 by 0·044	3·02 by 0·024	0·071	0·048	0·114
Ridley, Report of the "Alert" Sponges,	3·0 by 0·025	3·0 by 0·035	2·1 by 0·022 to 0·024			

The entire sponge varies from 7 to 11 mm. in horizontal diameter by 9 to 13 mm. in height. The ectosome (Pl. XII. fig. 41) varies from about 0·3 to 0·5 mm. in thickness, and consists of collenchyme in which very small fusiform cells are present, as well as collencytes, becoming particularly numerous beneath the outer epithelium (Pl. XII. fig. 41). They are chiefly tangentially arranged, but some few radially. The tissue of the ectosome is reduced to a minimum owing to its extensive excavation by the subdermal cavities (Pl. XII. fig. 39). These are traversed not only by the usual vertical spicular pillars and velar diaphragms, but also by horizontal partitions, which divide an outer smaller chamber in immediate communication with the pores from a larger inner chamber which is continued into an incurrent canal. The incurrent canals descend more or less radiately, taking a very irregular course, into the interior of the sponge. The oscule may be so small as to be invisible to the unaided eye, or it may attain a diameter of 2 mm.; its size probably depending to some extent on the state of contraction of its margin. The margin is formed by a thin muscular membrane, about 0·08 mm. thick, which roofs over the cloaca. The cloaca (Pl. XII. fig. 39) about 1 mm. deep by 0·725 mm. wide, has the form of a short cylindrical tube with a rounded base, its walls, about 0·3 mm. thick, or of the same thickness as the ectosome, consist of collenchyme; they are traversed by numerous excurrent canals, which open freely on the free face of the cloacal wall, but are guarded by a strongly sphinctrate diaphragm at the level of the deeper face, where they enter the choanosome proper. The margin of the oscule is not fringed with spicules, but the walls of the cloaca are traversed by slender oxeas (4) which render its free surface finely hispid (Pl. XII. fig. 39). The excurrent canals as they leave the cloaca and enter the sponge are provided at first with collenchymatous walls, and are crossed by velar

diaphragms; both vela and collenchyme, however, disappear as the canals subdivide into branches. The main incurrent canals are also constricted by vela.

The cloacal wall is in direct continuation with the ectosome, of which it appears to be an invaginated portion, its roof or the oscular margin arising as a prolongation or outgrowth of the tissue at the angle of flexure.

The mesoderm of the choanosome is a true sarcenchyma, the separate cells of which are sometimes very clearly displayed (Pl. XII. fig. 42). The flagellated chambers are somewhat smaller in the specimens from Station 208 than in those from Station 186; in the latter they are usually about 0·0276 mm. broad by 0·02 mm. long; in the former they vary from 0·016 to 0·02 mm. in diameter. The aphodal canals are usually short and sometimes absent, so that occasionally the chambers are eurypylous. The scleroblasts of the large spicules are clearly shown in the thin slices of the sponge, and in some instances can be traced extending over the cladome of a triæne, as represented in the illustration (Pl. XII. fig. 43), which shows an accumulation of scleroblastic protoplasm over the cladome of an anatriæne.

Symbiotic Alga.—The collenchyme of the ectosome (Pl. XII. fig. 41) and the canal walls is infested by an Alga, the presence of which was remarked by Ridley also in the specimens he examined. Ridley compares it to a *Nostoc*, and it appears to closely resemble the Phycochromaceous Alga which Schulze observed in *Spongelia pallescens*, and which he named *Oscillaria spongeliæ*.[1] Both Schulze's specimens and those in *Myriastra clavosa* are about 4 mm. in length, but they differ slightly in other dimensions; thus the disc-shaped cells of *Oscillaria spongeliæ* are about 0·006 mm. in diameter and 0·004 mm. in thickness, while those of the Australian form are 0·008 mm. in diameter and 0·0045 mm. thick.

Myriastra clavosa, var. *quadrata*, Sollas.

Myriaster quadrata, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 189, 1886.

Sponge.—Small, free, rounded below, constricted above into three lobes; on the upper surface a depression between the lobes, in which a single small oscule, surrounded by a membranous margin, is situated. Pores in sieve-like areas, generally distributed.

Spicules.—I. Megascleres. 1. *Oxea*, straight or curved, fusiform, sharply pointed; 2·56 by 0·0158 mm.

2. *Dichotriæne*, a straight or curved, conical, sharply pointed rhabdome; protocladi projecting outwards and forwards, the deuterocladi extending horizontally. Rhabdome 3·206 by 0·0276 mm., protocladi 0·11 mm., deuterocladi 0·27 mm. in length.

3. *Anatriæne*, a long, slender, conical, sharply pointed rhabdome, with thin, conical,

[1] *Zeitschr. f. wiss. Zool.*, Bd. xxxii. p. 147, pl. v. fig. 7, pl. viii. figs. 9 and 10.

sharply pointed cladi springing from the cladal end at right angles, and, after proceeding from one-third to one-half their course, recurving till they are nearly parallel to the rhabdome. Rhabdome 3·14 by 0·02 mm., cladi 0·1 mm. long; length of cladome 0·095 mm., chord 0·143 mm.

II. Microsclere. 4. *Chiaster*, rays tylote; 0·008 mm. in diameter.

Colour.—Puce-grey.

Habitat.—Station 212, January 30, 1875; lat. 6° 54′ N., long. 122° 18′ E.; depth, 10 fathoms; bottom, sand.

Remarks.—This sponge, of which there is a single specimen, measuring 10 mm. in height and 15 mm. in breadth, with a single oscule 1 mm. in diameter, is distinguished from *Myriastra clavosa* by the characteristic form of the cladome of the anatriæne. This, the difference in colour, and other minor particulars led me at first to regard the sponge as a distinct species; but, after recognising the variability of *Myriastra clavosa*, I think it may be more convenient to describe it as a variety of that species merely. The colour, moreover, does not appear to be proper to the sponge, for I could not discover pigment-cells; it is probably produced by one or other of the infesting protophytes.

Myriastra toxodonta, Sollas (Pl. XIV. figs. 29–36).

Myriastra toxodonta, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 189, 1886.

Sponge (Pl. XIV. fig. 29).—Small, in form a prolate ellipsoid, free; on one side a depression lined by smooth membrane, on the margin of which a few small oscules appear to open; pores in sieve-like areas generally distributed; surface even, rough.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XIV. fig. 30), fusiform, straight or curved, sharply pointed; 3·42 by 0·0316 mm.

2. *Dichotriæne* (Pl. XIV. fig. 31), a long, slender, conical rhabdome, usually thickened immediately below the cladome for a distance of about 0·08 mm.; protocladi projecting outwards and forwards, deuterocladi extending horizontally; rhabdome 3·5 by 0·046 mm., enlarging to 0·0597 mm. below the cladome, protocladi 0·095 to 0·127 mm., deuterocladi 0·286 to 0·318 mm. in length.

3. *Anatriæne* (Pl. XIV. fig. 32), a long, slender, conical, sharply pointed rhabdome, with recurved, conical cladi proceeding from it at wide angles; rhabdome 3·6 by 0·0237 mm., cladi 0·1114 mm. long; sagitta 0·0796 mm., chord 0·175 mm.

II. Microsclere. 4. *Chiaster* (Pl. XIV. figs. 33–35), actines thick, sometimes minutely spined, with tylote, minutely spined ends, 0·01 to 0·0158 mm. in diameter.

Colour.—Greyish-white.

Habitat.—Station 203, October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; depth, 20 fathoms; bottom, mud. Trawled.

Remarks.—There is but a single specimen of this sponge in the collection; it measures 14 mm. in length by 11 mm. in breadth.

Its resemblance to *Myriastra clavosa* is so considerable that I should have included it in that species, but for the larger size of the cladome of the anatriæne, and the thickening of the rhabdome of the dichotriæne below the cladal origin. This latter character would not alone appear to be of much importance, but since it appears very early in the development of the spicule, giving to it a striking and unusual appearance, very different from that of the young forms of the corresponding spicule in *Myriastra clavosa*, I am disposed to set some value on it. The chiasters are also distinguished by slight differences, the actines are usually thicker and fewer in number, reductions to three or even two being frequent; the tylote terminations are also better developed, and sometimes become subdivided into three or more rounded lobes. The ectosome is 0·3 mm. thick; the flagellated chambers 0·024 by 0·016 mm. in length and breadth, they are frequently eurypylous; the apopyle measures about 0·016 mm. in diameter.

Genus 2. *Pilochrota*,[1] Sollas.

Oscules usually distinct. Pores in sieves leading into radial incurrent canals, which are not constricted on passing through the fibrous layer of the cortex. Ectosome differentiated to form a cortex, which usually consists of a middle collenchymatous layer, an outer thin fibrous layer and an inner thicker fibrous layer. The microsclere is a chiaster.

Pilochrota haeckeli, Sollas (Pl. XIV. figs. 1–8).

Pilochrota haeckeli, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 189, 1886.

Sponge (Pl. XIV. fig. 1).—Subglobular; attached to it are numerous foreign bodies, which are most abundant around the oscule.[2] The oscule is single, oval, and with a smooth, thickened, membranous margin; it leads into a large cloaca, the sides of which, close to the oscule, are hispid with minute, projecting, oxeate spicules. The surface is rough, the poriferous sieves being situated in pit-like depressions surrounded by non-poriferous ridges, into which the radiating spicules of the interior enter.

Spicules.—I. Megascleres. 1. *Somal oxea* (Pl. XIV. fig. 2), stout, fusiform, usually curved and sharply pointed, 2·07 by 0·046 mm.

2. *Cloacal* and *ectosomal oxea*, small fusiform, sharply pointed, 0·2 by 0·004 mm.

3. *Orthotriæne* (Pl. XIV. fig. 3), rhabdome conical, stout below the cladome, rapidly attenuating to an almost filiform extremity, extremely sharply pointed or

[1] πῖλος ὁ, felt; χρώς ὁ χρωτός, the skin.

[2] In the illustration the sponge is represented with the surface bearing the oscule (which is not shown) turned downwards.

rounded off at the end; cladi simple, diverging almost at right angles from the rhabdome, conical, sharply pointed. Rhabdome 2·18 by 0·055 mm., cladi 0·238 to 0·318 mm. long.

4. *Anatriæne* (Pl. XIV. fig. 4), rhabdome stout, conical, much attenuated proximally, either exceedingly sharply pointed or rounded off at the end, cladi long, conical, sharply pointed, proceeding for a very short distance approximately at right angles to the rhabdome, and for the rest of their course recurved nearly parallel with it. Rhabdome 3·03 by 0·035 mm., cladi 0·16 mm. long; sagitta 0·16 mm., chord 0·16 mm.; thickness of cladome 0·0478.

II. Microsclere. 5. *Chiaster* (Pl. XIV. figs. 5, 6), no perceptible centrum; actines very slender, rod-like, tylote, few in number, commonly from three to seven, 0·016 mm. in diameter.

Colour.—Grey.

Habitat.—Samboangan, Philippine Islands; depth, 10 fathoms.

Remarks.—The single specimen of this sponge measures about 27 mm. in height and breadth; the oscule measures 4 mm. in diameter, and leads into a cloaca about 6 mm. deep; it is almost concealed by foreign bodies, which are attached by strong fibrous bands growing out from the cortex. The pores, from 0·015 to 0·06 mm. in diameter, open into chones of about 0·4 mm. in average diameter. The chones in their course through the cortex are crossed by several velar diaphragms, and continue by unconstricted apertures into the large incurrent canals of the choanosome.

Ectosome.—The cortex, about 0·8 to 0·95 mm. in average thickness, presents, as seen under a 1-inch objective, two well-marked and contrasted layers, the inner consisting of the deeply stained fibrous tissue usual in this position; and the outer, 0·32 mm. in thickness, of pale, unstained, polygonal cells, amidst which are embedded in places, sharply defined, rounded balls or clusters, from 0·06 to 0·22 mm. in diameter, of deeply stained polygonal cells.

Under a higher magnification one makes out the following details. Beneath the outer epithelium (Pl. XIV. fig. 7) is a layer from 0·02 to 0·04 mm. thick, consisting of collenchyme traversed by numerous, tangentially disposed, small, fusiform cells about 0·04 mm. in length. Beneath this follows the layer of pale granular cells just alluded to; these are now found to lie in oval cavities in a collenchymatous matrix, each in its own cavity, which in the living state it probably completely filled. Although, owing to the abundance of these cells, the collenchyme is reduced to a mere intercellular network, it still retains its characteristic stellate collencytes, the branching processes of which, as they stain deeply, can be clearly traced extending through the partitions between adjacent granular cells. Long slender fusiform cells also extend through this tissue, sometimes singly and sometimes in fibrous strands. The granular cells of this curiously modified collenchyme are polygonal or irregular in outline, about 0·012 mm. in diameter, with a

spherical nucleus about 0·004 mm. in diameter. They consist of finely granular, apparently protoplasmic, material. In two instances a chiaster was seen in the interior, apparently *in situ*. The darkly stained clusters of cells which occur embedded in this layer are sharply defined from it; the constituent cells (Pl. XIV. fig. 8) are about 0·016 mm. in diameter, and consist of translucent homogeneous material, incompletely divided into numerous lobes or completely divided up into little rounded masses about 0·004 mm. in diameter. No nucleus is apparent in these cells. Similar cells to these also occur irregularly scattered separately through the cortex, and more abundantly through the choanosome, especially adjacent to the walls of some of the canals. These separate cells are about 0·02 mm. in diameter, and usually consist of a number of quite isolated little spherical bodies, homogeneous, deeply stained, and translucent, and about 0·004 mm. in diameter. The inner fibrous layer of the cortex has the structure usual to it. It frequently sends strands of fibres into the outer cellular layer, which thus becomes more or less divided up into a number of separate masses.

Choanosome.—The flagellated chambers measure about 0·024 by 0·02 mm. in breadth and length; there is a single prosopyle to each, which in many cases measures about 0·004 mm. in diameter, the apopyle is wider, 0·008 mm., and leads into a longer or shorter aphodal canal. The mesoderm is a sarcenchyme.

Pilochrota pachydermata, Sollas (Pl. XXXVIII. figs. 18–27).

Pilochrota pachyderma, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 190, 1886.

Sponge (Pl. XXXVIII. figs. 18, 19).—Massive, irregularly lobate, raised into irregular rounded ridges; free, bearing several foreign bodies attached to the base by fibrous bands. Two or more oscules on the upper surface, with strong membranous margins; wall of the cloaca smooth and imperforate for some distance from the oscule, afterwards receiving the excurrent canals by several small simple mouths. Pores in sieves, sieves collected into patches, chiefly present in the depressions between the ridges of the surface. Surface smooth.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XXXVIII. fig. 20), slender, fusiform, usually curved and sharply pointed, 1·193 by 0·0178 mm.

2. *Orthotriæne* (Pl. XXXVIII. fig. 21), rhabdome conical, attenuating to an exceedingly sharp point; cladi conical, at first diverging outwards and forwards, but rapidly curving into horizontality. Rhabdome 1·114 by 0·022 mm., cladi 0·12 mm. long.

3. *Anatriæne* (Pl. XXXVIII. fig. 22), rhabdome cylindrical, attenuated to an exceedingly sharp point; cladi at first rising from the rhabdome outwards and forwards, but rapidly recurving outwards and backwards; the cladome in consequence depressed in front; rhabdome 1·35 by 0·0158 mm., cladi 0·067 mm. long, chord 0·099 mm.; sagitta 0·055 mm.

II. Microsclere. 4. *Chiaster*, slender, hair-like actines, abruptly terminated, but not tylote, proceeding from a minute globular centre; diameter 0·006 to 0·011 mm.

Colour.—Purplish on the surface, yellowish-white within.

Habitat.—Reefs off Tahiti; depth, 30 to 70 fathoms.

Remarks.—The single specimen obtained of this sponge measures 59 mm. in width and breadth, and 32 mm. in height. Two oscules were visible, of which the largest measures 3 by 4 mm. in diameter.

Ectosome.—The cortex (Pl. XXXVIII. fig. 25), on an average 1 mm. in thickness, is composed of fusiform cells, collected together in variable number, sometimes as many as twenty side by side, into fibres which cross each other chiefly in tangential planes, but sometimes, especially in the outer two-thirds, in a curved radial direction. Immediately beneath the investing epithelium is the usual thin layer of vesicles, about 0·004 by 0·007 mm. in length and breadth, with their contained protoplasm deeply stained. At intervals also in this position occur oval or round clusters of granule-cells, about 0·045 to 0·1 mm. in diameter. These are well shown, as seen from above, in the figure of a tangential slice taken from the exterior of the cortex (Pl. XXXVIII. fig. 24). In this figure are also seen the pore-sieves and diverging cladi of the triænes.

At the edge of the oscule the outer layer of the cortex is extended to form a membranous ocular margin about 0·03 to 0·25 mm. in thickness. It consists of a readily staining matrix, bounded by epithelium, and containing granular cells in the middle, and on each side of these occasional fusiform cells of small size. These are directed towards the nearest epithelial surface, with which their distal extremities come in contact.

The ocular or cloacal cavity, as it descends through the cortex (Pl. XXXVIII. figs. 26, 27), is lined by a very evident epithelium, the constituent cells of which bulge outwards like a succession of small vesicles; within them a nucleus is clearly discernible. Below the epithelium is a pale layer about 0·04 mm. in thickness, contrasting strongly with the dark hue of the fibrous tissue of the cortex which bounds it on the inner side. Under a low power (Pl. XXXVIII. fig. 26), the epithelial edge of this lining layer appears transversely striated, and when viewed under higher magnification (Pl. XXXVIII. fig. 27), this is found to result from the presence of deeply stained elongate cells, which are of two slightly different forms, though otherwise similar; the one presents a more or less cylindrical portion, 0·0078 mm. long by 0·0055 mm. broad, in which the nucleus is situated, it ends by a broad base against the epithelium on the one hand, and at the opposite extremity is produced into one or two fine fibres which are directed towards the fibrous tissue of the cortex. The other is fusiform in shape, and ends against the epithelium in a rounded conical end, which in some cases appears to be produced into a fine hair-like process, though I could not make sure whether this was not the torn margin of an epithelial cell.

The inner half of the pale lining layer contains numerous small vesicular cells, 0·008 to 0·012 mm. in diameter, with a small spherical nucleus, and very probably surrounded by a protoplasmic envelope, though this cannot be made out in my preparations. The inwardly directed fibrils of the cylindrical and fusiform cells sometimes disappear amidst these vesicular cells, but I have never been able to trace them into connection, sometimes, on the other hand, they continue their course till they reach the fibrous tissue of the cortex. It is also to be noted that strands of fibres from this tissue sometimes enter the pale lining layer of the cloaca and extend up to the investing epithelium.

Choanosome.—The mesoderm is a sarcenchyme; numerous deeply stained granule-cells are scattered through it.

The flagellated chambers measure about 0·024 by 0·017 mm. in breadth and length. The pore-sieves (Pl. XXXVIII. figs. 24, 25), open into wide cylindrical chones, which communicate freely by unconstricted apertures with wide incurrent canals.

Pilochrota gigas, Sollas (Pl. XX. figs. 1–13).

Pilochrota gigas, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 190, 1886.

Sponge (Pl. XX. fig. 1) massive, rounded; free, attaching to itself by fibrous bands numerous small stones. Several large oscules on the upper surface, which is incrusted with numerous foreign bodies. The ocular margin strongly membranous, partly concealing the large roomy cloaca into which the excurrent canals open by large mouths, which are overspun by a coarsely-meshed network. The pores in sieve-like areas, irregularly distributed, leading into chones, from which the incurrent canals proceed, sometimes traversing as single tubes the whole thickness of the sponge. Surface uneven, not rough, nor hispid.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XX. fig. 2), isoactinate, stout, fusiform, straight or somewhat curved, not sharply pointed; 1·678 by 0·0387 mm.

2. *Oxea* (Pl. XX. fig. 3), slender, fusiform, anisoactinate; distal thicker than proximal half, which is sometimes attenuated to a filiform extremity; 3·18 mm. by 0·0237 mm.

3. *Orthotriæne* (Pl. XX. fig. 4), rhabdome conical, attenuated to an excessively sharp or filiform extremity; cladi simple, conical, curving outwards and slightly forwards, frequently abruptly reflexed near the end. Rhabdome 1·96 by 0·0387 mm., cladi 0·223 mm. long.

II. Microsclere. 4. *Chiaster* (Pl. XX. figs. 5, 6), centrum very small or absent; actines excessively fine, tylote, somewhat numerous; diameter 0·013 mm.

Colour.—Yellowish-white.

Habitat.—St. Paul's Rocks, August 29, 1873. Taken with a fishing line from the shore.

Remarks.—This fine sponge, 200 mm. in length, 125 mm. in breadth, and 82 mm. in

maximum height, was brought up on a fishing line used from the shore; it is now divided into two parts by a transverse section, but no part is missing. The surface is more or less incrusted with foreign bodies; on the upper surface these are chiefly small fragments of shell, on the sides and lower surface small pebbles, which are attached by strong fibrous bands.

There are as many as six large oscules on the upper surface, the largest measuring 12 by 8 mm. Each opens through a thick membranous margin into a large cloacal cavity, within which a species of Ophiurid is sometimes found. The walls of the cloaca are produced into ridges and thick membranous partitions, between which the excurrent canals open by round or oval apertures, which are spanned over by a fibrous network with large oval meshes.

The ectosome, as in other species of *Pilochrota*, extends further inwards than in most corticate sponges, in so far as it surrounds the canals, which in other sponges would be known as the subcortical crypts; its total thickness varies from 1·1 mm. to 1·6 mm.; the distance from the surface to the homologues of the subcortical crypts is 0·5 mm. to 0·65 mm. on an average. Beneath the outer epithelium is a layer of chiasters, followed by a darkly stained fibrous felt, usually about 0·16 mm., but sometimes reduced to 0·03 mm. in thickness; this passes into a layer of collenchyme 0·24 mm. thick, containing numerous fusiform cells; oval vesicular cells 0·012 mm. in diameter, and apparently empty except for a very evident nucleus, 0·004 mm. in diameter; and faintly or not at all stained granule-cells, which occur singly or in groups of from two or three to a great number, forming oval or round clusters 0·06 mm. to 0·1 mm. in diameter. These last cells, when occurring singly, are oval in outline, and about 0·012 mm. to 0·016 mm. in diameter. The component granules are spherical and of very uniform size, about 0·002 mm. in diameter; they appear to be stained at the edges, but not in the middle, an appearance which may be due to the presence of an intracellular protoplasmic network. An oval granular space, about 0·004 mm. in diameter, is sometimes present amidst the granules, and is often more deeply stained than they are; it may represent a nucleus. When aggregated in clusters the cells become polygonal by appression, and are sometimes separated from each other by thin deeply-stained partitions, which form a kind of intercellular framework. Though most abundant in the outer half of the cortex, these cells and cellular aggregates are not confined to it, but occur generally throughout the sponge, and are especially noticeable in the walls of the larger water canals. Occasionally they spread out immediately below the lining epithelium of a canal in a single layer, which has somewhat the appearance of a layer of granular epithelial cells, like those figured by Poléjaeff in his Report on the Calcareous Sponges.[1]

The middle collenchymatous layer of the cortex passes into an inner fibrous felt, 0·24 mm. thick, and beneath this lie the intercortical canals, which are homologous with

[1] Poléjaeff, Zool. Chall. Exp., part xxiv. pl. viii. fig. 8.

subcortical crypts. These are surrounded by collenchyma containing numerous fusiform cells, which are collected in places into fibrous strands or felts.

The walls of the larger canals in the choanosome are similarly constituted. The velar diaphragms of these canals consist of a middle layer of fusiform cells, faced on each side by epithelium, on the inner face of which chiasters are abundantly scattered. The fibrous tracts extending from the cortex along the sides of the spicular bundles are strongly developed. The flagellated chambers are small, about 0·022 by 0·02 mm. in breadth and length, they communicate by long aphodal canals with the excurrent canals, and with the incurrent canals by prosopyles (Pl. XX. fig. 8).

The chones have the irregular form usual in the genus (Pl. XX. fig. 7).

The bands for attachment are smooth, tough processes of the cortex, often attaining a length of 5 mm. or more. The attachment to a foreign body is brought about simply by an accurate adaptation of the two surfaces, that of the foreign body and that of the end of the process, to each other. A longitudinal section of an average-sized band is shown in Pl. XX. fig. 10. A narrow longitudinal fissure in the interior, continuing the direction of an irregular cleft at the attached end and lined by epithelium, remains to indicate the origin of the process in two outgrowths of the cortex, that have subsequently coalesced. A curved fissure, as shown in the figure, separates a more solid lower part from a cavernous upper part. The latter consists chiefly of collenchyma excavated by numerous irregular cavities, and containing numerous vesicular and fusiform cells. The lower part is almost entirely composed of fusiform cells, lying in a stained matrix and running longitudinally downwards; in fig. 11, which is turned sideways up, these are shown much folded by the contraction of the surrounding tissue. Between the fusiform cells oval unstained granule-cells occur, singly and in strings of two or three or more (fig. 9). Associated with these granule-cells are others of similar size, consisting of darkly-stained protoplasm, enclosing two or three vacuoles and a nucleus; these appear to be the parents of the granule-cells; other granule-cells in a state of exhaustion are present. The attached surface of the process is invested with epithelium, against which the fusiform cells terminate in the manner shown in fig. 12.

The margins of the longitudinal fissure are represented as transversely striated in fig. 10. This is the appearance they present under slight magnification, more powerful objectives resolve this striation into a layer of small fusiform cells. At one end of the fissure these are continued into the general fibrous structure of the band, but elsewhere they are more or less separated from the main mass of fibres by the stained matrix of the fibrous tissue, free from fibres, but containing two or three dark irregular blotches, which have somewhat the form of multipolar ganglion cells. The fusiform cells are darkly stained and about 0·04 mm. long, and the amœboid cells, which look like blotches, occur near their inner ends. In any other position one might, but for their excessive numbers, suspect these fusiform cells of a sensitive function.

Pilochrota tenuispicula, Sollas (Pl. XV. figs. 28–32).

Pilochrota tenuispicula, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 190, 1886.

Sponge (Pl. XV. fig. 28), small, irregularly spherical, free. A single comparatively large oscule on the upper surface, with a membranous margin, leading into a large and deep cloaca, on the walls of which numerous excurrent canals open. Surface smooth, partly incrusted with foreign bodies raised into a honeycomb-like reticulation of smooth ridges; in the depressions between these, the pore-sieves, overlying the chones, are situated.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XV. fig. 29), varying from a stout, fusiform, somewhat sharply pointed variety to a slender anisoactinate form, having its greatest diameter nearer the distal than the proximal end, from 1·35 to 2·3 by 0·16 mm.

2. *Orthotriæne* (Pl. XV. fig. 30). Rhabdome slender conical, attenuated to very sharply pointed proximal extremity; cladi simple, conical, and extending horizontally almost immediately on leaving the rhabdome, frequently crooked, and otherwise crippled. Rhabdome 1·6 by 0·16 mm., cladi 0·12 mm. long.

II. Microsclere. 3. *Chiaster* (Pl. XV. fig. 31), rare, a small but evident centrum and very slender actines, not tylote; 0·012 mm. in diameter.

Colour.—Puce-grey.

Habitat.—Bermuda.

Remarks.—There is a single specimen of this sponge, 14 by 11 mm. in width and breadth, and 10 mm. in height. The single oval oscule measures 3 by 1·5 mm. in diameter.

Ectosome.—The cortex (Pl. XV. fig. 32), from 0·5 to 0·72 mm. in thickness, consists chiefly of fusiform fibres distributed as in *Pilochrota pachydermata;* beneath the outer epithelium is a layer of variable constitution, 0·02 mm. thick; it is not clearly defined from the rest of the cortex, but appears as in the other species of this genus to consist of the collenchymatous matrix which forms the basis of most of the tissues, freer in this case of cellular elements than elsewhere; the gelatinous basis is stained by hæmatoxylin, and contains in addition to tangentially disposed fusiform cells (though these are sometimes absent), either the minute vesicular cells, about 0·009 mm. in diameter, previously described, or minute oval protoplasmic bodies, about 0·003 mm. in diameter, which may be the protoplasmic parts of the vesicular cells without the enclosing vesicle; these little bodies are prolonged into a slender, darkly stained fibril, which proceeds from their distal end towards the outer epithelium, 0·02 mm. distant, against which it terminates. Similar bodies occur in many other sponges, and some are figured from the ectosome of *Azorica pfeifferæ* (Pl. XXXVI. fig. 22). Beneath this outermost layer occur the round oval clusters or balls of cells, which appear to be constantly present in species of this genus. They may

attain a diameter of 0·25 mm., and are chiefly composed of cells in a non-granular state, consisting of deeply stained protoplasm somewhat vacuolated; some of the constituent cells, however, consist of unstained finely granular material, and similar colourless granular cells occur separately scattered amidst the fibrous tissue of the cluster-bearing zone.

Choanosome.—Amidst the deeply stained sarcenchyma of the mesoderm are numerous scattered cells, each lying in a small cavity, caused probably by *post-mortem* shrinkage. These cells are of various sizes, the largest about 0·02 mm. in diameter, and they consist of deeply stained, finely granular protoplasm, enclosing a well-marked oval nucleus about 0·01 mm. in length, and in this again is a small spherical nucleolus about 0·002 mm. in diameter. Besides these cells are others similar, but consisting of a network of unstained material bearing minute stained granules on the nodes; these appear to result from exhaustion of the stained cells.

The flagellated chambers vary from about 0·016 by 0·02 to 0·02 by 0·024 mm. in length and breadth.

Chones.—The chones have the irregular canal-like form common in the genus. The cortex immediately adjacent to them is somewhat modified, forming a thin layer next the lining epithelium less fibrous than elsewhere; in the homogeneous matrix of this layer minute fusiform cells about 0·04 to 0·07 mm. long appear, they lie with the long axis at about right angles to the lining epithelium, against which the outwardly directed fibril terminates; the fibril of the opposite extremity is lost amidst the fibrous tissue of the cortex.

The chiasters, which are rare, are best observed in superficial tangential sections of the cortex, where they will be found in comparative abundance immediately below the epithelium around the margin of the pores.

Pilochrota crassispicula, Sollas (Pl. XIV. figs. 9–15).

Pilochrota crassispicula, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 190, 1886.

Sponge (Pl. XIV. fig. 9), irregularly spherical, about 3·5 cm. in diameter, free, numerous foreign bodies attached to the surface by strong fibrous bands, a single large oscule at the summit, with a membranous margin, leading into a long tubular cloaca, which descends obliquely into the sponge; excurrent canals opening in the walls of the cloaca by numerous mouths, spun over by a coarse reticulation, each mesh of which is occupied by a sphinctrate velum. Pores in sieves, overlying chones; situated chiefly at the bottom of narrow grooves, which form a network of depressions over the surface, giving it a kind of embossed appearance.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XIV. fig. 10), a massive, straight or curved, fusiform variety, sharply pointed, or pencil pointed, or rounded off near the point, 2·3

by 0·0513 mm.; and a long slenderer variety, anisoactinate, with the maximum diameter nearer the distal than the proximal end, which is frequently attenuated to a filiform extremity, 3·5 by 0·0237 mm.

2. *Orthotriæne* (Pl. XIV. fig. 11); rhabdome conical, slightly constricted below the cladome, almost cylindrical for the first distal fifth of its course, and then attenuating rapidly to an almost filiform, sharply pointed extremity; cladi conical, diverging from the rhabdome outwards and forwards, and suddenly reflected close to the pointed end, so as to become horizontal or bent backwards; one of the cladi may occasionally, but rarely, bifurcate past the point of retroflexion. Rhabdome 2·36 by 0·079 mm., cladi 0·254 mm. long.

II. Microsclere. 3. *Chiaster* (Pl. XIV. figs. 12, 13), varying from a smaller form with a distinct centrum and short actines to a larger without a visible centrum and longer actines, actines in both forms usually tylote, in the larger sometimes much reduced in numbers, roughened and thickened; smaller form about 0·012, larger 0·016 to 0·0197 mm. in diameter.

Colour.—Greyish-white.

Habitat.—Bahia, September 1873; depth, 7 to 12 fathoms.

Remarks.—There are two complete specimens of this sponge in the collection; the largest measures 37 mm. in height and 40 in width by 32 in breadth. The single oscule is 5 mm. in diameter, and the cloaca, which enters the sponge very obliquely, running almost parallel with the surface, is nearly 20 mm. in length. Its roof for a considerable part of its course is furnished by the membrane of the oscular margin. The ectosome (Pl. XIV. fig. 14) is a cortex of variable thickness, depending on the size of the subcortical canals, and usually ranging from 0·8 to 1·0 mm. It is widely excavated by the ectochones, which are of various sizes, their roof is perforated by the short canals of numerous pores. The ectochones often communicate below, several together, with a common canal, which runs parallel to the surface, and appears to represent the endochones and subcortical crypts of other corticate sponges. Beneath the outer epithelium and its associated chiasters lies a thin layer of fusiform cells variously orientated parallel to the surface; on the inner face of this numerous oval vesicles, about 0·008 mm. long, are scattered; they contain a darkly stained protoplasmic body, which about half fills them, and appear to be prolonged into two darkly stained fibrils, one proceeding from each end; in many cases they lie with their long axis pointing at right angles towards the outer epithelium up to which the fibril from the outer end extends, while the other fibril descends into the general tissues and becomes lost to view. Next succeeding is a layer of tissue, consisting partly of fusiform cells, partly of collenchyma, the former predominating, but not always to the same extent; the fusiform cells of this layer wander in tangential, radial, and intermediate directions, and frequently run parallel to the sides of the ectochones. This layer

passes about the inner ends of the ectochones into a fibrous tissue in which the fusiform cells run tangentially, and are variously orientated. The remaining part of the cortex is that which surrounds the tangential canals, the representatives of the endochones and crypts of other sponges; it is partly collenchymatous and partly fibrous in constitution.

In addition to the elements just described, clusters of granule-cells are present, chiefly distributed immediately below the outermost layer of fibrous tissue; they vary from about 0·1 by 0·06 mm. to about 0·2 by 0·18 mm. in diameter, though some are smaller. Each cell, about 0·016 mm. in diameter, is wholly composed of unstained, colourless granules of remarkably uniform size. Between the cells is a thin layer of darkly stained protoplasm, which separates them from each other, forming an intercellular network throughout the cluster. A variable number of the cells, sometimes more, sometimes less, are of very different characters to the others; remaining of the same size, they present a well-stained oval nucleus about 0·005 mm. in diameter, enclosing a minute spherical nucleolus, and surrounded by a film of darkly stained protoplasm, which extends in radiating processes to the periphery of the cell; or, instead of this protoplasm, a number of isolated, deeply stained spherical granules may be present. The granules of the unstained cells, on the other hand, are so numerous that they lie contiguous in a solid mass.

The ectosome is continued as a membrane 0·16 to 0·19 mm. thick over the cloaca, and forms a rounded margin to the oscule (Pl. XIV. fig. 14). This oscular membrane is very similar in composition (Pl. XIV. fig. 15) to the rest of the ectosome, consisting of a stained matrix traversed by fusiform cells, which take chiefly a concentric direction around the oscule, but are also partly radiately arranged. Isolated granular cells and clusters of these cells are also present, and, at a little distance below the outer epithelium, the minute vesicles previously mentioned. On the upper surface of the membrane, near the oscular opening, these are very clearly seen, with one fibril running to the outer epithelium, and the other losing itself in the general tissue. The tissue of this oscular membrane extends down the sides of the cloacal tube as a lining layer, 0·26 mm. thick. This presents below the outer epithelium first a layer of chiasters, then of fusiform cells longitudinally arranged, altogether about 0·03 mm. thick; this is underlaid by clusters of granule-cells, forming a layer, traversed by fibrous strands, of about 0·05 mm. thick. The rest of the cloacal wall, about 0·19 mm. in thickness, consists of fibrous tissue, the fibres running both longitudinally and concentrically. The walls of the larger canals are also formed chiefly of fibrous tissue and associated granule clusters; these fibrous walls are frequently 0·1 mm. in thickness.

The Choanosome.—The mesoderm is a typical sarcenchyma, with the sarcencytes very clearly defined as small polygonal cells about 0·012 mm. in diameter. In some of them young forms of asters, about 0·004 mm. in diameter, are well displayed; the central part of the cell, as far as the ends of the actines of the aster, is of much paler colour than the

surrounding protoplasm of the exterior of the cell, appearing as a pale circular area within a darkly stained granular field, bounded by a polygonal margin. In one instance, instead of a young aster, two minute siliceous globules were observed within the spicule cell. Fibrous strands are frequently seen wandering irregularly through the sarcenchyma.

The flagellated chambers vary from about 0·0197 by 0·0237 mm. to 0·0237 by 0·0276 mm. in length and breadth.

The structure of the fibrous bands by which foreign objects are attached to the sponge is similar to that described under this head in *Pilochrota gigas*.

Pilochrota purpurea, var. *longancora*, Sollas (Pl. XIV. fig. 37).

Pilochrota longancora, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 190, 1886.

Sponge, small, somewhat quadrangular, cushion-shaped, with rounded margins; free. A single circular oscule on the upper surface, in the centre of a circular periproctal membrane or cloacal roof. Margin of the oscule minutely fimbriated by a short fringe of minute oxeas projecting radiately in the plane of the aperture. Surface of the sponge rough, uneven; pores lying in irregular winding channels or pits, separated by irregular spicular ridges and pillars.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, straight, or more usually slightly curved; sharply, but sometimes abruptly pointed; 1·63 by 0·035 mm.

2. *Orthotriæne*; rhabdome conical, sharply pointed, with simple cladi, projecting at first outwards and forwards, but curving into horizontality toward the end. Rhabdome 2·1 by 0·047 mm., cladi 0·35 mm. long.

3. *Anatriæne*; rhabdome long, slender, conical, sharply pointed, but sometimes rounded off at the end; cladi conical, making a large angle with the rhabdome, and only slightly recurved. Rhabdome 3·5 by 0·0237 mm., cladi 0·075 mm. long, sagitta 0·048 to 0·06 mm.; chord from 0·127 to 0·14 mm.

4. *Oxea* of the oscular membrane, minute.

II. Microsclere. 5. *Chiaster*, 0·009 mm. in diameter in the ectosome, increasing to 0·012 mm. in the choanosome.

Colour.—Ashen-grey; the choanosome of a brownish-white tint.

Habitat.—Torres Strait, August 1874; depth, 3 to 11 fathoms.

Remarks.—This sponge is almost identical with *Stelletta purpurea*, Ridley, being chiefly distinguished by the much greater length of the anatriæne. There is but one specimen in the collection; it measures 20 by 15 mm. in length and breadth, and 11 mm. in height. The circular oscule is 1·5 mm., and the surrounding membrane 3 mm. in diameter.

Ectosome.—The cortex, 0·48 to 0·63 mm. in thickness, much resembles that of *Pilochrota haeckeli*; the outer two-thirds, or 0·318 mm., is a collenchyma, containing long fusiform cells running in all directions, clusters of deeply stained granule-cells (Pl. XIV. fig. 37), and separately scattered cells, composed of faintly staining finely granular material lying in cavities of the collenchyma, and in some places so numerous as to constitute the greater part of the tissue. The chones, as usual in the genus, are irregular in form, traversing the cortex as canals of various diameter, and usually converted into a succession of vesicles by well-developed velar diaphragms.

The flagellated chambers measure about 0·0276 by 0·02 mm. in breadth and length.

Pilochrota anancora, Sollas (Pl. XIV. figs. 16–22).

Pilochrota anancora, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 190, 1886.

Sponge (Pl. XIV. fig. 16), small, spherical, depressed, free. A single oscule situated on one side of a membranous area or cloacal roof. Surface uneven; pores large, in sieves; situated in winding, channel-like depressions.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XIV. fig. 17), varying from a somewhat stout, fusiform, usually curved, sharply pointed form, 1·68 by 0·023 mm., to a longer, slenderer, anisoactinate form, with its greatest diameter nearer the distal than the proximal end; proximally attenuating, often to a filiform, excessively sharply pointed extremity; distally variously pointed, excessively sharply or pencil-pointed, or rounded off close to the end; 3·18 by 0·021 mm.

2. *Orthotriæne* (Pl. XIV. fig. 18), a conical rhabdome, usually rapidly attenuating proximally to a filiform sharply pointed extremity; cladi simple, straight, conical, sharply pointed. Rhabdome 1·63 by 0·0276 mm., cladi 0·127 mm. long.

II. Microsclere. 3. *Chiaster* (Pl. XIV. figs. 19, 20), a small centrum with numerous fine rod-like actines, terminally tylote; total diameter 0·0118 mm.

Colour.—Cream-white.

Habitat.—Bahia; depth, 7 to 20 fathoms.

Remarks.—The single specimen of this sponge measures 15 by 16 by 11 mm.; the oscule is a little less than 1 mm., and the oscular membrane about 3 mm. in diameter. The latter is not fringed with oxeas as in *Pilochrota purpurea*. The ectosome (Pl. XIV. fig. 21) or cortex is about 0·72 mm. in thickness, the outer layer, for a distance inwards of 0·24 to 0·35 mm., excavated by wide somewhat irregularly shaped ectochones, the inner, 0·4 mm. in thickness, by the inferior cortical canal, into which the ectochones open. The structure of the cortex resembles that of *Pilochrota crassispicula*, from which the present species is chiefly distinguished by the slenderness of the rhabdome of its orthotriæne; it is possible that this character may not be of specific importance,

and that *Pilochrota anancora* is simply a young form of *Pilochrota crassispicula*. The choanosome is similar to that of *Pilochrota crassispicula*, but the mesoderm is less abundantly developed. The canals are provided with thick fibrous walls, and numerous fusiform cells help to form the spicular tracts. Clusters of granule-cells, though present in the cortex (Pl. XIV. figs. 21, 22), are far less numerous in the choanosome. The canals are provided with numerous vela, and I observed here, as I have in other instances, that a velum is sometimes perforated by two circular apertures, each surrounded by concentric myocytes.

The flagellated chambers are aphodal, though sometimes a few appear to be eurypylous; they measure 0·0276 by 0·031 mm. in length and breadth, and the prosopyle, which in many cases is exceptionally clearly shown, is single and usually measures about 0·012 mm. in diameter.

The sponge is of much softer texture than *Pilochrota haeckeli* and *Pilochrota longancora*, which are hard and harsh to the touch.

Pilochrota moseleyi, n. sp.

Sponge compressed, ellipsoidal or thumb-shaped, attached below, bearing a single oscule near the summit; ostular margin fringed with minute oxeas. Pores in sieves, evenly dispersed.

Spicules.—I. Megascleres. 1. *Somal oxea*, fusiform, straight or curved, more or less sharply pointed; 1·2 by 0·016 mm., and 1·4 by 0·013 mm.

2. *Oscular oxea*, small, fusiform, sharply pointed.

3. *Orthotriæne;* rhabdome conical, pointed or rounded off near the apex; cladi conical, pointed, extending horizontally almost immediately after diverging from the rhabdome. Rhabdome 1·6 by 0·05 mm., cladi 0·2 mm. long.

4. *Anatriæne;* rhabdome conical, pointed or rounded off near the apex; cladi curving evenly backward almost immediately past their origin, the cladome in consequence well rounded in front. Rhabdome 1·6 by 0·02 mm., cladi 0·083 mm. long, chord 0·103 mm. sagitta 0·082 mm.

II. Microscleres. 5. *Ectosomal chiaster*, a small but evident centrum, and numerous fine, hair-like, truncated actines; total diameter 0·008 mm.

6. *Choanosomal chiaster*, no evident centrum, actines few in number, usually from five to seven, slender, rod-like or somewhat conical, roughened, abruptly truncate, seldom tylote; total diameter 0·024 mm.

Colour.—Greyish-white.

Habitat.—Torres Strait, August 7, 1874; depth, 3 to 11 fathoms.

Remarks.—There is but a single specimen of this sponge, it measures 14 mm. in height, and 9 by 12 mm. in width and breadth. The single circular oscule is 2 mm. in

diameter, and leads into a tubular cloaca about 3 mm. in depth. Its systematic position is a matter of much perplexity. The choanosomal chiaster may be regarded as foreshadowing the anthaster of other Stellettids, and it may be preferable to assign the sponge to the genus *Anthastra*. The cortex is thin compared with most species of *Pilochrota*, from 0·32 to 0·48 mm. in thickness, but since the outer layer to the thickness of 0·24 to 0·32 mm. consists of fibrous tissue, its place would seem to be with this genus. The inner layer of the cortex, from 0·10 to 0·24 mm. thick, but not always present, consists of collenchyma in which, however, fusiform cells are usually present in more or less abundance. In the outer fibrous layer oval or round balls of granule-cells are present in considerable numbers; they are about 0·1 mm. in diameter. The pores lead either immediately or by communicating canals into the chones, which are about 0·08 to 0·16 mm. in diameter, and usually open by wide unconstricted apertures into large incurrent canals, the roots of which frequently extend tangentially beneath the cortex. In one of these tangential extensions an Annelid, 0·24 mm. in diameter and over 2·0 mm. in length, was observed; it was evidently living when the sponge was placed in spirits, and from the neatness with which it fills the canals, looks very much like an inhabitant. The chones are frequently crossed by velar diaphragms, at the level of the inner surface of the fibrous layer and sometimes at other levels. Concentric myocytes surround the lumen of the diaphragm, and small fusiform cells, about 0·04 mm. in length, may sometimes be seen radiating from it; similar cells extend inwards from the sides of the chones; in both cases the outwardly directed end of the cell stands in contact with the free epithelial surface. In one case a conical cell, with a base about 0·004 mm. wide applied against the epithelium, was observed; the conical body of this cell measures 0·008 mm. in length, is produced inwards into a delicate fibril 0·012 mm. long, and presents at the middle a well-marked oval nucleus, 0·004 mm. in length, containing a small spherical nucleolus.

The flagellated chambers measure 0·024 by 0·02 mm. in breadth and length. The canals, both excurrent and incurrent, contain large quantities of finely granular material, pointing to the fact that the animal was actively feeding at the time it was captured. The choanocytes, 0·004 mm. in diameter at the base, are deeply stained, and the protoplasm of the base appears more than usually granular.

Pilochrota lendenfeldi, n. sp. (Pl. VII. fig. 5).

Sponge (Pl. VII. fig. 5) more or less spherical, supported on a short stalk; no visible oscules; pores in sieves generally distributed. Cortex comparatively thin.

Spicules.—I. Megascleres. 1. *Oxea*, stout, fusiform, usually curved, sharply pointed, 2·5 by 0·0434 mm.

2. *Orthotriæne;* rhabdome conical, attenuated towards the end, which is either sharply pointed or rounded off near the point; cladi simple, conical, projecting first outwards and forwards, and in the middle of their course bending into horizontality. Rhabdome 2·856 by 0·05526 mm.

3. *Anatriæne;* rhabdome conical, much attenuated proximally, usually rounded off near the point, otherwise sharply pointed; cladi proceeding horizontally for only a very short distance before becoming recurved; thus the front of the cladome is semicircular in outline. Rhabdome 1·75 by 0·0237 mm., cladi 0·1 mm. long; sagitta 0·095 mm., chord 0·127 mm.

II. Microsclere. 4. *Chiaster*, varying from a minute form, with an evident centrum and short numerous actines, to a somewhat larger variety without a perceptible centrum, and longer, sometimes roughened actines; actines in both forms tylote. Diameter of the smaller form 0·007, of the larger 0·0118 mm.

Colour.—A dark umber-brown externally, internally yellowish-grey.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells. Dredged.

Remarks.—The single specimen of this sponge measures 17 mm. in width; its total height is 20 mm., made up of 15 mm. for the somewhat spherical body, and 5 mm. for the stalk, which is 5 mm. in width. The surface of attachment is oblique to the axis of the stalk.

The systematic position of this sponge is more doubtful than that of *Pilochrota moseleyi;* it differs from all other species of the genus in the absence of an evident oscule, and the cortex differs considerably from the type. The canals or chones descending from the pores open into a system of tangential canals from which the incurrent canals of the choanosome proceed. The tangential canals, about 0·24 mm. in diameter, separate an outer from an inner cortical layer. The outer, 0·32 mm. in thickness, consists of collenchyma containing abundant fusiform cells, which wander in all directions, and render it fibrous. This is faced externally by a layer of fibrous tissue 0·02 mm. thick, invested with epithelium. In this layer also occur oval or round balls of granule-cells, and numerous isolated granule-cells. The inner layer, also about 0·32 mm. in thickness, consists of large, densely stained fusiform cells running in various directions in tangential planes. They form more or less separate layers, and, between the deeper lying of these, islands of choanosome are included. There is thus an interlaminar passage between the cortex and the choanosome.

The flagellated chambers are large compared with those of other species of the genus; the following are measurements—0·0276 by 0·02, 0·032 by 0·025, and 0·0355 by 0·0276 mm. in breadth and length.

Genus 3. *Astrella*, Sollas.

The cortex is well developed, consisting of a thick outer layer of collenchyma, sharply defined from a thick inner layer of fibrous tissue: the collenchyma passes into a thin fibrous layer beneath the investing epithelium. Pores in sieves. Chones completely differentiated, consisting of a main canal lying in the collenchymatous layer, proximally constricted into a narrow tube which passes through the inner fibrous layer, distally subdivided into several branches, each of which underlies a pore-sieve. The microsclere is a pycnaster.

Astrella vosmaeri, Sollas (Pl. XVI. figs. 1–5; and Pl. XL. fig. 8).

Astrella vosmaeri, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 193, 1886.

Sponge (Pl. XVI. fig. 1), irregularly prolately ellipsoidal, or compressed cylindrical, with rounded edges; serving as a basis of attachment to *Stelletta phrissens*. Surface hispid, where the spicules are worn away regularly embossed. Oscules not distinguishable from the pores. Pores comparatively large, in sieves, generally distributed. Chones large, much branched towards the exterior.

Spicules.—I. Megascleres. 1. *Oxea*, stout, fusiform, not sharply pointed, 3·138 by 0·0592 mm.

2. *Dichotriæne* (Pl. XVI. fig. 2); rhabdome conical, terminating proximally in a rounded end about 0·015 mm. thick; protocladi projecting outwards and forwards, deuterocladi conical, usually rounded off near the ends, horizontal. Rhabdome 3·02 by 0·0789 mm., protocladi 0·0876 mm., deuterocladi 0·238 mm. long, chord 0·636 mm.

3. *Anatriæne* (Pl. XVI. fig. 3); rhabdome somewhat fusiform, rounded off at the proximal end when about 0·006 mm. thick; cladi diverging outwards and only slightly backwards for about the first fifth of their course, backwards and only slightly outwards for the remaining four-fifths. Rhabdome 3·61 mm. long, 0·0237 mm. thick below the cladome, then diminishing to 0·0197 mm., increasing to 0·0276 mm., and finally attenuating to a rounded end about 0·001 mm. in diameter; cladi 0·0395 mm. long, chord 0·0395 mm., sagitta 0·0395 mm.

II. Microsclere. 4. *Pycnaster* (Pl. XVI. fig. 4), a small centrum passing into short, thick, obtusely truncated conical actines, from 0·0118 to 0·0158 mm. in diameter.

Colour.—Purplish-grey, darker on the upper exposed surface than underneath.

Habitat.—Station 308, off Tom Bay, Patagonia, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ 0″ W.; depth, 175 fathoms; bottom, blue mud. Trawled.

Remarks.—Two specimens of this sponge were trawled, bearing attached to them a specimen of *Stelletta phrissens*, which in the one case is much larger than its support (Pl. XVI. fig. 1), and in the other much smaller. The larger of the two specimens of

Astrella rosmaeri measures 30 mm. in height, 45 mm. in width, by 41 in breadth; the smaller is about 35 mm. long by 23 mm. wide. In neither, after a careful search, could any trace of an oscule be discovered. The surfaces of both are worn nearly smooth, as if the sponges had been rolled about on the sea-bottom, the hispidating spicules remaining only where protected by the attached sponge and at the opposite pole. The pores measure from 0·025 to 0·0775 mm. in diameter, they occur in sieves which overlie the ends of the canals forming the chones. The chones (Pl. XL. fig. 8) consist of a canal which sends off numerous branches towards the dermal membrane, each branch terminating beneath a pore-sieve. A single chone thus receives water from several pore-sieves, and may drain an area 1·5 mm. in diameter. In some cases, however, only one or two branches are given off from the main canal. In the other direction the canal is continued inwards through the fibrous layer of the cortex with a very much diminished diameter; it is easily traced in thick slices by the layer of scattered pycnasters which accompany it, and which extend over the face of the sphinctral muscle which closes its inner end. This sphincter forms a ring-like swelling on the inner face of the cortex around the end of the chonal canal.

Ectosome.—The cortex consists of a thin outer layer of fibrous tissue, 0·06 mm. in thickness, covered by the external epithelium and its underlying layer of pycnasters; of a thick layer of clear collenchyma, 1·0 to 1·5 mm. in thickness, containing, in addition to a network of collencytes, elongated fusiform cells, which, however, are not numerous enough to give it a fibrous appearance; and finally of an inner layer of fibrous tissue, the component fusiform cells of which are arranged in the usual way, *i.e.*, in fibres which run concentric with the surface in various azimuths; this layer varies from 0·16 to 0·475 mm. in thickness, and the total thickness of the cortex varies from 1·35 to 2·0 mm. Where the megascleres pass through the cortex the inner fibrous layer is produced outwards into conical extensions, which surround the cladal ends of the rhabdomes; a single rhabdome with the attached fusiform cells extending obliquely downwards from it on all sides into the fibrous layer may frequently be observed.

Choanosome.—The mesoderm is a sarcenchyma, amidst which fusiform cells are sometimes seen wandering, especially in the neighbourhood of the canals. The chones lead into subcortical crypts, which, like the larger excurrent canals, are furnished with collenchymatous walls, in which, in addition to the plexus of collencytes, deeply stained fusiform cells, and rarely large granular cells elongated in the same direction as the fusiform cells, are to be seen. Although no discoverable oscules exist, there is no difficulty in distinguishing the incurrent from the excurrent canals, the interdigitation of the two systems being very clearly revealed in good sections. The large excurrent canals, with collenchymatous walls, communicate with the flagellated chambers only by their terminal branches, and never directly through the walls; indeed, branch canals may sometimes be observed extending between the surrounding sarcenchyma and the collenchyma

of the canal walls, or excavating the sarcenchymatous face of the latter, in order to supply the adjacent chambers. The incurrent canals appear to communicate directly with the adjacent chambers wherever they may lie. The flagellated chambers are small, on an average 0·02 by 0·0275 mm. in length and breadth.

One must not omit to mention that, in the collenchymatous canal walls, cylindrical cells with swollen bases, extended into one or more long filaments, are to be observed, the cylindrical end in which the nucleus is situated lying contiguous to the lining epithelium, and the filamentous end radiating into the plexus of collencytes.

The remaining Stellettidæ are heterasterose, *i.e.*, more than one form of microsclere is present; the additional microsclere may be another euaster, a sanidaster, amphiaster or microrabd.

Subfamily 2. Euasterina.

Heterasterose Stellettidæ, in which the additional microsclere is a euaster.

Genus 4. *Anthastra*, Sollas.

Sponge usually more or less spherical; oscules distinct or not; pores in sieves overlying subdermal cavities. Ectosome thin, collenchymatous; excavated by extensive subdermal cavities. In addition to a chiaster an anthaster is present.

Anthastra pulchra, Sollas (Pl. XII. figs. 1–28).

Anthastra pulchra, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 191, 1886.

Sponge (Pl. XII. fig. 1) small, globular, free. A single small oscule on the summit. Pores in cribriform areas, generally distributed. Surface even, harsh to the touch. The oscule is surrounded by a membranous margin, and leads into a cloaca, which receives several comparatively large excurrent canals opening into it by sphinctrate mouths.

The ectosome is from 0·318 to 0·478 mm. thick.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XII. fig. 2), fusiform, straight, or more usually curved, somewhat sharply pointed; from 2·39 to 3·1 by 0·0315 mm.

2. *Orthotriæne* (Pl. XII. fig. 3), a conical rhabdome, very sharply pointed or rounded off close to the point; simple conical cladi, rapidly and regularly curving out into horizontality. Rhabdome 2·6 to 2·9 by 0·0474 mm., cladi 0·25 to 0·27 mm. long.

3. *Anatriæne* (Pl. XII. fig. 4), a conical rhabdome, very sharply pointed or rounded off close to the point; cladi extending horizontally for from one-third to one-half of their course, and then curving backwards and outwards. Rhabdome 2·6 to 2·9 by 0·0315 mm., cladi 0·125 mm. long, chord 0·181, sagitta 0·1114 mm.

II. Microscleres. 4. *Anthaster* (Pl. XII. figs. 7–13), actines conical, spined, varying

from two to seven in number; a single actine of a tetrad form measures about 0·0158 by 0·004 mm.

5. *Chiaster* (Pl. XII. figs. 6, 14, 15), varying considerably in size and general character; a small form with a comparatively large centrum and numerous short actines, about 0·008 mm. in diameter, and a larger form, with a smaller centrum and longer actines, 0·012 to 0·0158 mm. in diameter. In both the actines are abruptly terminated, hair-like rods, sometimes conical and pointed, scarcely if ever tylote.

Colour.—Yellowish-white.

Habitat.—Station 163A, off Twofold Bay, Australia, April 4, 1874; lat. 36° 59′ S., long. 150° 20′ E.; depth, 150 fathoms; bottom, green mud. Dredged.

Remarks.—Ten specimens of this sponge were dredged; the largest does not exceed 14 mm. in diameter, with an oscule 1·5 mm. wide. The smallest is 10 mm. in maximum width, with an oscule 0·5 mm. in diameter.

The oscule (Pl. XII. fig. 23) leads obliquely into a small cloaca, into which the excurrent canals open by sphinctrate apertures. The perforated muscular membrane, thus tympanising the ends of the excurrent canals, may be regarded as a highly developed velum. Velar diaphragms occur at intervals throughout the whole extent of both incurrent and excurrent canals. The excurrent canals diverge from the cloaca on all sides towards the exterior, branching as they go, and interdigitating with the incurrent canals. The flagellated chambers (Pl. XII. fig. 28) vary from about 0·028 to 0·032 mm. in width, and 0·0197 to 0·024 in length; the prosopyle varies from about 0·007 to 0·01 mm. in diameter, and communicates with incurrent canal by a short prosodus. The apopyle is from 0·008 to 0·016 mm. in diameter, and is continued into an aphodus from 0·010 to 0·028 mm. long. The choanocytes are very sharply defined; a small but evident nucleus is seen within the rounded body, which is about 0·004 mm. in diameter; the collum is defined by a sharp outline on each side, and passes into the collar, which is continued into the common fenestrated membrane. Notwithstanding the clearness with which the foregoing characters are displayed, no trace of cilia is to be discovered.

The ectosome (Pl. XII. figs. 23–27) has the characters usual in the genus; its inner surface next the choanosome is not defined by any special fibrous layer, but exteriorly, beneath the outer epithelium, fusiform cells are abundantly present in the collenchyma of which it is constituted. Quite as numerous as the collencytes are the rounded clusters of bacteria which are strewn through this tissue (Pl. XII. fig. 25). The subdermal cavities may be regarded as a system of irregularly winding and branching superficial canals, crossed by numerous vela, and separated by the collenchyma of the ectosome, through which the spicular pillars proceed (Pl. XII. figs. 26, 27). The pores are collected in sieves overlying small canals, which descend directly into the subdermal cavities, and open into them freely or through a velar diaphragm; in some cases these pore-canals are

constricted into two divisions by a transverse velum (Pl. XII. fig. 24). The epithelium of the canals is very clearly shown in some parts of the thin slices, and frequently the outer membrane of the epithelial cells is supported on the tylote ends of the chiastral actines in tent-like projections. The cladi of early forms of the anatriæne project from the primitive tylus at right angles to the rhabdome, as shown in figs. 16–18, Pl. XII., the first two figures representing two successive stages in the growth of the spicule, while the third is a more highly magnified representation of the spicule illustrated in fig. 16. The cladi of the protriæne project outwards and forwards from the first (fig. 19). The tylus from which the cladi originate is well shown in the end view of a young triæne given in fig. 22.

The anthasters show no tendency to constancy in the number of the actines; six are frequently present, but five, four, three, and two are quite as common. The young anthaster is smooth, with conical pointed actines (figs. 20, 21); it is not an overgrown chiaster, but both probably are modifications of a more primitive form.

Both chiasters and anthasters are found alike in the choanosome and the ectosome, but anthasters are more numerous in the latter region than in the former, and are wholly absent near the centre of the sponge. The chiasters appear nearer the epithelial surfaces than the anthasters; thus in the ectosome they are plentifully scattered over the inner face of the lining epithelium of the subdermal cavities, almost to the exclusion of anthasters, which usually are more deeply seated in the collenchyma.

Anthastra communis, Sollas (Pl. XIII. figs. 1–29; Pl. XV. figs. 20–27).

Anthastra communis, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 191, 1886.

Sponge (Pl. XIII. figs. 1, 12, 13) nearly spherical when young, spherical, oval, or tuberose when older. Free or attached; frequently sparingly incrusted with foreign bodies. Oscules usually not distinguishable from the pores; in one specimen distinct, congregated. Pores in cribriform areas marked out by the cladi of the dichotriænes. Subdermal cavities forming winding, branched, anastomosing canals within the ectosome. Excurrent canals usually small, not distinguishable from those of the incurrent system. Surface even, rough to the touch, hispid in places.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XIII. figs. 2, 14; Pl. XV. fig. 23), fusiform, straight or slightly curved, variously pointed, obtusely or sharply, or tornotate or strongylate, 4·2 to 5·6 by 0·06 to 0·09 mm. A smaller oxea, apparently a young form of the preceding, is present, and forms within the ectosome radiating pencils at the ends of the radial spicular sheaves.

2. *Dichotriæne* (Pl. XIII. figs. 3, 15, 19; Pl. XV. fig. 24), a conical rhabdome, much attenuated proximally, sharply pointed or rounded off near the end; cladi bifurcate, protocladi projecting forwards and outwards, sometimes more outwards than forwards,

sometimes the reverse, in the latter case curved, giving the cladome a cyathiform appearance, in the former usually straight; deuterocladi sometimes extending horizontally, sometimes projecting slightly forwards. Rhabdome 4·418 to 5·7, by 0·09 to 0·11 mm., protocladi 0·143 to 0·16 mm. long, deuterocladi 0·19 to 0·48 mm. long, chord 0·524 to 1·114 mm.; distance from the cladal origin to the dichotomy of the arms measured along an imaginary line representing the axis of the rhabdome produced 0·095 to 0·16 mm.

3. *Anatriæne* (Pl. XIII. figs. 4, 21; Pl. XV. fig. 25), a conical rhabdome sharply pointed or rounded off near the end; cladi gently recurving from their origin backwards, or first projecting outwards and then recurving; cladome rounded or flattened in front. Rhabdome 3·0 to 4·3 by 0·032 to 0·039 mm., cladi 0·127 to 0·16 mm. long, chord 0·16 to 0·2 mm., sagitta 0·12 to 0·15 mm.

II. Microscleres. 4. *Anthaster* (Pl. XIII. figs. 5, 22–24; Pl. XV. fig. 26), centrum usually not enlarged; actines cylindrical or sometimes conical, minutely spined, either entirely, or partially, in the latter case free from spines near the origin; usually from three to seven in number, sometimes numerous; from 0·021 to 0·028 mm. long.

5. *Chiaster* (Pl. XIII. figs. 6, 25–28; Pl. XV. fig. 27), centrum usually not enlarged, but occasionally, though very rarely, forming a sphere of greater diameter than the length of the actines; actines slender, hair-like, usually smooth and tylote, sometimes thickened and roughened; sometimes ending abruptly, without becoming tylote; usually numerous; 0·006 to 0·008 mm. long.

Colour.—Greyish or cream-coloured white; in one group of specimens russet-red.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells. Dredged.

Station 163A, off Twofold Bay, Australia, April 4, 1874; lat. 36° 59′ S., long. 150° 20′ E.; depth, 150 fathoms; bottom, green mud. Dredged.

Port Jackson, June 3, 1874; depth, 6 to 15 fathoms.

Remarks.—A large number of specimens of this sponge were dredged. From Station 162 three specimens, from Station 163A thirty-five specimens, and from Port Jackson eleven specimens were obtained. After examining a few specimens from each station, I was inclined to regard those from different stations as belonging to three different species, the first distinguished by its reddish colour and minute difference in the chiasters; the second distinguished from the first by containing typical chiasters, and from the third by the straightness of the protocladi of the dichotriæne; and the third characterised by the curved form of the protocladi. On further examination, the characters of the spicules appeared to be subject to much variation, and I therefore made an examination of the spicules of nearly thirty specimens; the result showed that none of the differences observed in the spicular forms could be

relied on for specific or even varietal distinctions. In some of the specimens from Station 163A and from Port Jackson the dichotriænes are characterised by cyathiform cladomes (Pl. XIII. fig. 19) (*i.e.*, the protocladi are curved as along the sides of a cup), in others the cladomes are infundibular (*i.e.*, the protocladi are straight, diverging as along the sides of a funnel) (Pl. XIII. fig. 3). The cyathiform character is found to vary considerably, so that sometimes the cladomes approximate to the infundibular type, and at others become more cyathiform than usual; indeed, variations in this respect may be observed in the same individual sponge.

Carter has made use of the angle which the cladi of the chief triænes make with the rhabdome in the Geodiidæ to separate the sponges of this family into smaller groups; it is true that a character which is inconstant in one family may become of great importance in another, but it does not seem probable that a character which is not even of varietal importance in the Stellettidæ can be employed for making large divisions in the Geodiidæ; nor, on further examining into the value of this character in the Geodiidæ, do we find it more constant there than from the present instance we might expect.

The limits assigned to the dimensions of the spicules in the description above given were obtained from an examination of a considerable number of specimens, and apply to the species, not to the individual; within the limits of an individual the range of variation is comparatively slight. I do not suppose that this species is markedly more variable than others I have described; the simple explanation lies in the fact that more specimens were examined.

The smallest specimen measures about 8 mm. in diameter, the largest 48 by 38 by 40 mm.

The ectosome, which on an average is about 0·08 to 0·09 mm. thick, consists of cavernous collenchyma, and is so extensively excavated by the ectosomal canals that the tissue is restricted to forming the roof and floor of these canals, and the connecting pillars which are traversed by the spicular sheaves. Transverse vela, perforated by sphinctrate apertures, cross the ectosomal canals at intervals. Fusiform cells are present in the collenchyma, especially in the roof of the ectosomal canals; they are not more abundant in the floor, which passes into the choanosome, than elsewhere. Round or oval cells containing somewhat large, round, deeply staining, highly refringent granules (Pl. XIII. fig. 7) are common in the collenchyma, thickly dispersed through it; they also occur in the choanosome. The exterior of the ectosome contains a dense layer of anthasters.

From the ectosomal canals others arise which descend radially, parallel to the spicule sheaves into the choanosome; they are crossed at close intervals by the usual transverse vela. At the entrance of some of these canals into the ectosome, the latter is much thicker than elsewhere, and the ectosomal canal large and subdivided by horizontal partitions; this appears to distinguish in some cases the excurrent from the incurrent canals,

for I find that it marks the ends of those excurrent canals which terminate by simple ostia in an exceptional specimen to be further referred to later. The mesoderm of the choanosome is a sarcenchyma. The flagellated chambers (Pl. XIII. fig. 9) are very clearly and sharply defined in all their characters. The choanocytes present a rounded base with the usual nucleus and nucleolus, a short collum deeply stainable extends from it, and is continued into an unstained structure seen as two sharply marked lines in section; this is apparently the collar; the collar enters into the fenestrated membrane; the whole length of the cell is about 0·0118 mm. The prosopyle is single and large, about 0·0118 to 0·016 mm. in diameter; the apopyle appears usually to be smaller, from 0·008 to 0·012 mm. across; a narrow aphodus proceeds from it, on an average about 0·019 mm. long, but varying according to the distance to be traversed from the canal into which it flows and the chamber to which it belongs. The chamber always lies close to the ultimate wide branch of one of the incurrent canals, the prosopyle opening immediately into it or by means of a very short prosodus. The marked contrast between the large ultimate incurrent canals, with the layer of flagellated chambers immediately surrounding them, and the small branches of the excurrent system, with their repeated ramifications ending in a special aphodal canal for each flagellated chamber, is well shown in Pl. XIII. fig. 8.

The peripheral ends of the excurrent canals are no larger than those of the incurrent system, and only in a few specimens is an excurrent canal of large size to be met with at all, and this does not communicate directly with the exterior, but by means of smaller branches which run radially to the ectosome, to open by the usual cribriform pore-areas. These areas, which present the same characters whether serving for admission of water to the incurrent system or its ejection from the excurrent, occur between the deuterocladi of the dichotriænes; these, extending horizontally in the ectosome beneath the epithelium, form by their symmetrical disposition a very regular framework; within the areas of this framework (Pl. XV. fig. 20) the ectosomal roof is perforated by pores, from 0·004 to 0·015 mm. in diameter; the margin about each pore is very thin, consisting of an inner and outer layer of epithelium, with an excessively thin intervening layer of collenchyma containing a few fusiform cells; between the pores these increase in number as the collenchyma in thickness, forming a secondary framework of tissue within the primary spicular framework; the thickening of the framework does not affect the level surface of the exterior epithelium, but bulges out on the under surface of the roof, so that in transverse section each pore forms an opening at the summit of a low dome, the walls of which are formed by the secondary framework. In one specimen the areas at one end of the sponge are each occupied by a single aperture or ostium which replaces the fenestration just described. These ostia are the openings of excurrent canals.

In *Anthastra pulchra* and the present species we are presented with a series of stages in the modification of the excurrent canal system which serves to explain the

lipogastrism and lipostomism already indicated. There is always a single oscule in *Anthastra pulchra*, but, while always small, it varies considerably in size, and sometimes becomes so minute that it requires properly orientated thin slices to find it. In correspondence with the reduction of the oscule we find a reduction in the size of the main excurrent canals.

Passing to *Anthastra communis*, we find that the oscule has disappeared, being represented either by small ostia or most commonly by pore-sieves; the large excurrent canals are also reduced and have usually disappeared. The explanation which suggests itself is as follows:—With the reduction in size of the oscule the pressure within the excurrent canals (the size of the sponge, area of the pores, and extent of the flagellated surface remaining unchanged) must be increased; but the passage of water through the sponge depends on the pressure over the excurrent face of a flagellated chamber being less than that on its incurrent face, and hence this increase of pressure must be reduced. Now the branches of the excurrent canals run radially in all radiate sponges towards the ectosome, interdigitating with the incurrent canals. Continued growth will cause them to enter the ectosome and reach the exterior. There they find already built up the ectosomal spicular framework, and consequently when they open to the exterior they do so through areas, fenestrated or simply perforated, like those already established in connection with the incurrent tubes. The branches of the excurrent tubes having now established communication with the exterior, water can as easily, probably more readily, escape through them than through the main canals, which thus become of secondary importance. With the growth of the choanosome these then become pressed together and are finally obliterated, the branches alone sufficing for an excurrent system.

The development of the protriænes and anatriænes, after their earliest appearance, can be readily followed in sections of this sponge. The cladomes lie one behind the other in the radial sheaves, forming a series in which progressively younger forms are encountered as we pass from its distal to its proximal end. The youngest observed forms occur at a distance of about 2·4 to 3·2 mm. from the outer surface. The youngest protriæne (Pl. XIII. fig. 16) commences with a swelling or tylus at the distal end of a uniaxial spicule (oxea), produced at the broad distal margin into three short conical spines, traversed by axial fibres; these spines are the rudiments of the adult cladi. The axial fibres are quite straight, and project outwards and forwards, at an angle of about 120° with the axis of the rhabdome. Thus at an early stage all the triænes of the sponge are provided with simple cladi. With growth the spines of the protriænes increase in size and maintain their original direction, or, in the specimens with cyathiform cladomes, curve slightly inwards as they extend forwards. They presently bifurcate, the deuterocladi first appearing as exceedingly short processes with rounded ends (Pl. XIII. fig. 18); both primary and secondary cladi continue to increase in size as they are traced distally, the latter both in length and thickness, the former apparently only in thickness.

The anatriænes likewise present, in the first observed stage, a long rhabdome expanded distally into a somewhat obconical thickening, from which three small spines project at the distal margin (Pl. XIII. fig. 20); they diverge at first horizontally, or at right angles to the rhabdome, and preserve this direction for some distance in specimens characterised by cladomes flattened in front; in those with rounded cladomes a slight backward curvature is often very early observed; they subsequently grow backwards more than outwards, and so give rise to the adult form; a further deposit of silica may quite conceal the originally horizontal growth of the cladi, converting an originally flat-fronted into a round-fronted cladome; but the position and direction of the axial fibre remains unchanged, and faithfully records the successive change in direction of the growth of the cladi. The spicules of sponges grow outwards into the cortex, and are subsequently cast out from the sponge to be replaced by fresh ones; evidence of this forward growth is afforded by the sponge under description, since none but fully developed spicules are found with cladomes in the ectosome, and as we descend deeper into the sponge successively younger forms are met with ready to replace those in front as soon as they are cast out.

The large cells surrounding the spicules (Pl. XIII. fig. 10), and serving apparently as mother-cells, are well seen in many of the sections of the sponge. They occur about the middle of the oxeate spicules, but about two-thirds from the proximal end in both forms of triæne.

Anthastra parvispicula, Sollas (Pl. XIII. figs. 30–40; Pl. XL. figs. 1, 2).

Anthastra parvispicula, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 192, 1886.

Sponge (Pl. XIII. fig. 30), small, spherical, free, with a single small oscule. Pores in sieves, generally distributed. Surface even, soft to touch.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XIII. fig. 31), fusiform, usually curved, somewhat sharply pointed, 1·3 by 0·02 mm.

2. *Orthotriæne* (Pl. XIII. fig. 32), a conical, sharply pointed rhabdome; simple conical cladi, diverging from the rhabdome at a wide angle, and rapidly, somewhat suddenly bending into horizontality. Rhabdome 1·75 by 0·02 mm., cladi 0·21 mm. long.

3. *Anatriæne* (Pl. XIII. figs. 33, 34), a conical, sharply pointed rhabdome; stout, short, conical cladi, rapidly recurving till nearly parallel with the rhabdome; front of the cladome rounded. Rhabdome 1·3 by 0·016 mm., cladi about 0·045 mm. long, chord 0·0485 mm., sagitta 0·05 mm. long, thickness of cladal rhabdome 0·025 mm.

II. Microscleres. 4. *Anthaster* (Pl. XIII. figs. 35–37), as in *Anthastra pulchra*, but with somewhat slenderer, less coarsely spined actines; length of a single actine of a tetractinose form 0·014 mm., diameter 0·0035 mm.

5. *Chiaster* (Pl. XIII. fig. 38), a scarcely perceptible centrum and hair-like actines abruptly truncated, not tylote; diameter 0·0118 mm.

Colour.—Greenish-grey.

Habitat.—Station 161, off Melbourne, April 1, 1874; lat. 38° 22′ 30″ S., long. 144° 36′ 30″ E.; depth, 33 fathoms; bottom, sand. Trawled.

Remarks.—The ectosome (Pl. XIII. figs. 39, 40) is about 0·4 mm. in total thickness; the pores open directly into wide canals, which terminate below by freely opening into extensive subdermal cavities, from which the incurrent canals are produced inwards. These, like the excurrent canals, are widely open, crossed by vela with wide apertures, and surrounded by thin collenchymatous walls, in which fusiform and vesicular cells occur as well as collencytes. The ectosome, owing to the extensive subdermal cavities, is reduced chiefly to an outer layer, 0·13 mm. thick, forming the roof of these cavities, and to the pillars of tissue between them; the floor of the subdermal cavities is only separated from the choanosome by the epithelial lining and a discontinuous layer of vesicular cells, not more than 0·008 mm. in diameter. The ectosomal tissue forming the roof of the subdermal cavities consists of collenchyma, in which are abundance of fusiform cells, especially numerous immediately below the dermal epithelium; they lie tangentially, except in the pillars between the subdermal cavities, where they assume a radial direction. Just below the margin of the pores, directed at right angles to the surface of the poral canal, small, deeply stained, fusiform cells are in some cases conspicuously present; they are about 0·024 mm. long, it may be a little longer, and the nucleus is situated about 0·009 mm. from the outer end, which is in immediate contact with the lining epithelium of the canal, if indeed it does not penetrate it (Pl. XL. figs. 1, 2). In form, general characters, direction, and position these cells are strikingly similar to those which von Lendenfeld has interpreted as sense-cells.

The choanosome is a sarcenchyma. The flagellated chambers are about 0·03 by 0·024 mm. in length and breadth, the choanocytes 0·012 mm. in length, with a spherical body about 0·004 mm. in diameter; the collum can be traced as a double contoured band up to its entrance into the fenestrated membrane. The apopyle and prosopyle are of about the same diameter, from 0·008 to 0·015 mm.

Anthastra pyriformis, Sollas (Pl. XV. figs 1–19).

Ecionema pyriformis, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 192, 1886.

Sponge (Pl. XV. figs. 1, 2) somewhat obconic, attached by a flattened base, rising by straight sides, which pass by a gently rounded margin into a flattened or depressed upper surface, bearing numerous small oscules. Chief excurrent canals vertically ascending to open each by one or more chones in the oscules. Pores large, in sieves, generally distributed over the sides.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XV. fig. 3), massive, fusiform, sharply

pointed or not, straight or curved; varying in different specimens from 3·14 by 0·095 to 4 by 0·104 mm.

2. *Protriæne* (Pl. XV. fig. 6), rhabdome massive, conical, roundly pointed; cladi conical, stout. Rhabdome 2·86 by 0·1 mm., cladi 0·2 mm. long, chord 0·318 mm.

3. *Dichotriæne* (Pl. XV. figs. 4, 5), rhabdome massive, conical, much attenuated proximally, sharply pointed or rounded off near the point; protocladi diverging outwards and forwards; deuterocladi horizontal, conical, and obtusely pointed or rounded off. Rhabdome 3·02 by 0·095 to 3·72 by 0·163 mm., protocladi 0·1114 mm., deuterocladi 0·1114 to 0·175 mm. in length, chord from 0·7 to 0·79 mm.

4. *Anatriæne* (Pl. XV. figs. 7–9), rhabdome slender, conical, excessively sharply pointed or rounded off near the end; cladi extending outwards more than backwards; cladome rounded or slightly flattened in front. Rhabdome 2·0 to 2·1 by 0·023 mm., cladi 0·0158 mm. long, sagitta 0·0118 mm., chord 0·0276 mm.

II. Microscleres. 5. *Anthaster* (Pl. XV. fig. 10), actines bacillary with rounded ends, minutely spined, usually four to seven in number, but varieties in which they are more or fewer are present; a single actine of a tetrad form 0·013 by 0·00395 mm.

6. *Chiaster* (Pl. XV. fig. 11), no perceptible centrum, actines fine, hair-like, variable in number, tylote; a single actine 0·008 mm. long.

Colour.—In two specimens a purplish-grey, in a third yellowish-white.

Habitat.—Port Jackson, June 3, 1874; depth, 30 to 35 fathoms.

Remarks.—Two specimens of this sponge and part of a third are present in the collection. Of these, one measures 57 mm. in maximum height by 47 mm. in diameter, its basal attached surface is an irregular triangle about 22 mm. across; the second is 48 mm. in height, much enlarging from the base upwards, so that while the base measures about 25 by 18 mm., the somewhat oblong upper surface measures as much as 62 by 41 mm. The fragment is the lower part of the sponge bearing the surface of attachment, and since this measures about 22 mm. in diameter it indicates for the entire sponge a size similar to that of the other two. The small simple oscules of the upper surface measure about 1 mm. in diameter, sometimes more, sometimes less; the pores are large and do not, so far as one can judge under a strong simple lens, occur more than four or five together in a single sieve. The chones are simply the ectosomal ends of the canals, which undergo scarcely any modification on passing out of the choanosome, if any.

The ectosome (Pl. XV. fig. 12) is about 0·8 mm. in thickness, the outer 0·04 to 0·12 mm. consists of collenchyma crowded with fusiform cells running parallel to the epithelial surface, the rest of the ectosome is composed of collenchyma with well-developed collencytes. The collenchyma is in addition crowded with oval cells, 0·02 mm. in diameter, made up of deeply stained oval bodies about 0·004 mm. in diameter (Pl. XV. fig. 13). These

are so abundant as to apparently constitute the main portion of the collenchyma, through which they are evenly distributed; they are also common in the choanosome. Abundantly present along with these problematical cells in the ectosome are examples of a species of Diatomacea. Seen longitudinally (Pl. XV. fig. 19) they present an oblong outline with rounded angles, the largest measuring 0·13 by 0·24 mm., in transverse section (Pl. XV. fig. 18) they are square or oblong with rounded corners. Lying closely along the sides of the test are the remains of diatomin bodies, more or less oval in outline, with strongly marked annular margins, measuring from 0·006 to 0·01 by 0·004 mm. in length and breadth; protoplasm in any other form is absent. When first examined in glycerine great perplexity was felt as to the true nature of these structures; the sections did not give clear evidence of the bivalvular structure of the test, and it was taken for a cellulose cell-wall. Schulze's solution, however, gave no cellulose reaction, and the absence of starch in the contained bodies was indicated by iodine. Balsam preparations suggested a siliceous nature for the test, and on boiling out in nitric acid on a glass slide, this suggestion was confirmed; the test was then found to consist of two closely applied valves, which present by this mode of preparation a more oval outline than when mounted in glycerine. The closest examination, however, failed to reveal the slightest trace of any surface ornamentation. The species is apparently new, the genus probably *Amphora;* I propose to name it *Amphora archeri.*

The epithelial surfaces of the sponge are very usually raised into spine-like or hair-like projections, which in glycerine preparations look remarkably similar to sense-hairs or palpocils. Sometimes these projections are less concave in their curvature, and blunter than usual, as represented in Pl. XV. fig. 13. A small nucleus and nucleolus can usually be distinguished within and beneath them, and sometimes a fusiform cell or one of the processes of a stellate collencyte, directed at right angles to the epithelial surface, enters them. On comparing the glycerine with balsam preparations one finds that these spine-like eminences of the epithelium are produced by the actines of the underlying asters; and, from the association of a single epithelial nucleus with each projection, it looks as though only a single epithelial cell took part in the formation of the latter. I was able to trace the continuity of epithelial with underlying mesodermal cells in several instances; in some cases (Pl. XV. fig. 17) the epithelium was retracted into the mesoderm in little funnel-shaped pits, the blind end of which was continued into a densely stained conical cell about 0·006 mm. long, containing a small nucleus, and prolonged inwards as a fine fibril about 0·023 mm. long. In other cases a somewhat pyriform cell, with a large central cavity enclosing a deeply stained nucleus, was seen in immediate contact with the epithelial surface on the one hand, and extended as a slender, deeply stained fibril, 0·028 mm. in length, on the other.

The Skeleton.—The spicular fibres are closely packed to form a dense skeleton. They radiate from an excentric origin, indicated near the right hand bottom corner of the cut

face shown in Pl. XV. fig. 2. One remarkable fact in connection with them is the presence of well-developed protriænes throughout their whole course from the origin to the surface. The dichotriænes, evidently modifications of the protriænes, and the anatriænes, occur only near the surface, beyond which they do not project except in the sheltered depression shown in the upper edge of fig. 1. Here the anatriænes extend outwards for about 0·25 mm., and some of them, together with fully-developed oxeas, occur amidst some attached foreign material, free and completely extruded from the sponge.

The anatriænes are sometimes reduced to anadiænes and anamonænes, the latter somewhat resembling the anamonænes of *Tetilla pedifera*, except that the cladus is far shorter in length.

Anthastra ridleyi, Sollas.

Ecionema ridleyi, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 191, 1886.

Sponge ovate; a few papillary processes (apparently for attachment) at the lower end; several small oscules on the summit.

Spicules.—I. Megascleres. 1. *Oxea*, massive, fusiform, straight or curved, sharply pointed or not; 4·07 by 0·118 mm.

2. *Orthotriæne*; rhabdome conical, massive, sharply pointed or rounded off near the end; cladi stout, conical, diverging outwards and slightly forwards. Rhabdome 4·0 by 0·118 mm., cladi 0·27 to 0·32 mm. long, chord 0·58 mm.

3. *Anatriæne*; rhabdome slender, conical, sharply pointed; cladi diverging more outwards than backwards; front of the cladome rounded. Rhabdome 3·6 by 0·03 mm., cladi 0·103 mm. long, chord 0·183 mm., sagitta 0·08 mm.

II. Microscleres. 4. *Anthaster*, small, actines usually numerous, a single actine of a tetrad form from 0·01 by 0·0039 mm.

5. *Chiaster*, actines slender, hair-like, tylote, no visible centrum; 0·0158 mm. in diameter.

Colour.—Yellowish-white.

Habitat.—Port Jackson, June 3, 1873; depth, 30 to 35 fathoms.

Remarks.—The single specimen obtained of this sponge is a prolate ellipsoid, with a minor axis of 15 mm. and a major axis of 23 mm. It differs from *Ecionema pyriformis* in possessing orthotriænes instead of dichotriænes, and in the reduction of the anthaster, which differs only slightly from a chiaster. Both sponges bear a general resemblance to *Anthastra* (*Stelletta*) *tethyopsis*, Carter; which, however, is distinguished by much larger megascleres, the oxea measuring 8·68 by 0·05 mm., and the dichotriæne 8·68 by 0·07 mm.

Genus 5. *Stelletta*, O. Sch.

Oscules may or may not be evident. Pores in sieves overlying completely differentiated chones. Cortex well developed, consisting of an outer collenchymatous layer passing externally into a thin fibrous layer, and of a clearly differentiated thick inner fibrous layer. Chones completely differentiated. Of the two forms of aster, one is characteristic of the ectosome and the other of the choanosome, though neither is confined to the region it characterises. The ectosomal asters, however, form a layer beneath the outer epithelium, from which the choanosomal aster is rigidly excluded.

Stelletta phrissens,[1] Sollas (Pl. XVI. figs. 6–20).

Stelletta phrissens, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 192, 1886.

Sponge (Pl. XVI. figs. 6, 7) spherical to cylindrical, compressed, with rounded edges; attached. Surface bristling with spicules which project for a distance of 6 to 7 mm.; embossed, a polygonal network of linear depressions defining low rounded swellings or bosses, about 2 to 3 mm. in diameter. Pores in sieves, chiefly distributed over the linear depressions and the sides of the bosses. Oscules small, not exceeding 1 mm. in diameter, distributed in scattered groups. Cortex thick, consisting of an outer collenchymatous and an inner fibrous layer without special spicules, except for a single layer of minute spherasters occurring immediately below the outer epithelium.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, obtusely pointed, 4·65 by 0·073 to 4·89 by 0·07 mm.

2. *Dichotriæne* (Pl. XVI. fig. 8); a stout conical rhabdome, below the cladome faintly constricted, then for a short distance cylindrical or bulging, finally attenuating, till when about 0·0125 mm. in diameter it ends in a rounded point; protocladi curving forwards and outwards, cyathiform; deuterocladi conical, bluntly pointed, diverging horizontally. Rhabdome from 3·5 by 0·118 to 4·19 by 0·12 mm., protocladi from 0·127 to 0·143 mm. long, about half the length of the deuterocladi, which are about 0·254 to 0·303 mm. long, chord of the cladome 0·7 mm., of the deuterocladi 0·286 mm.

3. *Anatriæne* (Pl. XVI. fig. 9) a somewhat fusiform rhabdome, first diminishing in thickness from the cladome proximally, then increasing, and finally diminishing, till when about 0·008 mm. in diameter, it ends in a rounded point; cladi conical, with obtuse or rounded points, gently curving outwards and scarcely backwards for one-third of their length, then somewhat suddenly bent more backwards than outwards; cladome slightly projecting in front. Rhabdome from 8·72 to 8·1 mm. long; 0·051 wide below the head, diminishing to 0·037, and then increasing to 0·058, finally attenuating to 0·008 mm. in diameter, and ending in a rounded point.

[1] φρίσσω, to bristle.

II. Microscleres. 4. *Oxyaster* (Pl. XVI. fig. 10), a comparatively small centrum produced into few or many conical sharply pointed actines, smooth or minutely spined, each about 0·0198 to 0·027 mm. long, by 0·003 to 0·004 mm. wide.

5. *Spheraster* (Pl. XVI. fig. 11), a comparatively large centrum, produced into very numerous short conical or rod-like actines, abruptly truncated at the ends, usual diameter 0·01 mm.

Colour.—Faint yellowish-white.

Habitat.—Station 308, Tom Bay, Patagonia, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ 0″ W.; depth, 175 fathoms; bottom, blue mud. Trawled.

Remarks.—There are several examples of this sponge in the collection; the largest measures 70 by 46 mm. in length and breadth, and 61 mm. in height. It is firmly attached to a specimen of *Astrella rosmaeri*; in another case a *Cydonium magellani* furnishes a surface of attachment. The hispidating spicules are, in most cases, worn off from the greater part of the surface, the embossed character of which thus becomes revealed.

The cortex (Pl. XVI. fig. 12) measures about 1·75 mm. in thickness; immediately beneath the outer epithelium follows a layer of spherasters one aster thick; this is succeeded by a very thin layer (about 0·0118 to 0·0276 mm. in thickness) of fusiform cells lying tangentially in various directions, this layer is reflected down the sides of the radial spicular bundles; it passes on its inner side into a thick layer (0·9 mm.) of collenchyma, containing numerous fusiform cells which wander irregularly through it; this layer passes into a thick fibrous felt (0·48 mm. thick) composed of bundles of fusiform cells running tangentially in all directions (Pl. XVI. fig. 13).

The chones are broken up into numerous irregular vesicular canals within the collenchymatous cortex, but within the fibrous layer they form well-defined cylindrical tubes, which are closed at their inner ends by thick sphinctral muscles, consisting of concentrically-arranged myocytes (Pl. XVI. fig. 12).

The choanosomal mesoderm is a sarcenchyma, but in one specimen it becomes collenchymatous where it surrounds the larger canals, forming a wall about them from which flagellated chambers are absent (Pl. XVI. fig. 14). The flagellated chambers range from about 0·02 by 0·02 mm. to 0·04 by 0·03 mm. in length and breadth; the aphodal canal is frequently from 0·02 to 0·04 mm. long and about 0·012 mm. in breadth.

No genital products were observed in any of the specimens, but several very small young sponges were found attached to the hispidating spicules. Of these serial sections were cut in several cases, and they afforded results of some importance relating to the development of the chones and cortex. The smallest of the young sponges from which slices were prepared was approximately spherical and measured about 0·635 mm. in diameter. The ectosome is very thin (0·0275 mm. thick) and consists of collenchyma,

invested by the outer epithelium, below which, as in the adult sponge, is a single layer of minute spherasters. Beneath the ectosome lie the subdermal cavities (Pl. XVI. fig. 15), about 0·161 mm. high, measured radially, and of very various widths. The pillars between the adjacent cavities are in many cases devoid of flagellated chambers, in others the chambers extend more than halfway into them; the boundary between the ectosome and the choanosome is therefore inconstant and ill defined. All the forms of spicules which the sponge will at any time possess are already developed, but the oxyasters are very rare, and are evidently later developments than the spherasters; the other spicules also, except the spherasters, are very much smaller than in the adult, and of quite different proportions. The dichotriænes, the cladomes of which already support the ectosome, have thus a very different appearance from that which they present later, but almost precisely resemble the young dichotriæne of *Thenea*. The smallest measured presented a rhabdome 0·039 mm., protocladi 0·013 mm., and deuterocladi 0·045 mm. in length; thus the deuterocladi alone are longer than the rhabdome, and an entire dichocladus is almost twice as long. In the fully grown sponge, on the other hand, the rhabdome is about seven times the length of the dichocladus; in other words, while the dichocladus increases in length about seven times, the rhabdome increases almost ninety times in passing from the young to the adult state; at the same time the protocladi increase in length relatively to the deuterocladi; in the young sponge the latter are about three times the length of the former, in the adult not more than twice.

In this stage the young sponge forcibly reminds one of a *Thenea*, and from a young *Thenea* only essentially differs in the characters of the asters, and in the presence of a sarcenchymatous mesoderm.

The young sponge (Pl. XVI. fig. 17)[1] next to be described was very fortunately orientated with regard to the plane of the razor, and, owing to this, reveals in the clearest manner the relation of the chones and subdermal cavities to each other, as well as the nature of the canal system generally. It was considerably larger than the preceding, about 1·1 by 1·27 mm., but still approximately spherical. The ectosome forms a continuous layer of unequal thickness, about 0·1 mm. on an average, entirely surrounding the sponge; within it the choanosome is seen as a strongly folded layer, connected with the ectosome only where the outer crests of the folds become continuous with it. The outside sinuses of the folds are the incurrent canals not yet differentiated from the subdermal cavities, which are now merely the broad outer ends of the outer sinuses bounded by the ectosome and by the pillars through which this and the choanosome pass into each other. The inside sinuses of the folds are the excurrent canals, and the common cavity with which they are continuous is the remains of the paragaster, which communicates with the exterior by a single oscule.

[1] A woodcut in which the structure represented in this figure is worked out in greater detail is given in the introduction.

The mesoderm of the choanosome is a sarcenchyma in this as in the preceding individual, and in both the flagellated chambers are aphodal. The aphodal canals have not the appearance of metamorphosed folds, and are more probably produced by the growth of the surrounding mesoderm converting the original eurypyles into narrow canals.

The ectosome evidently does not share in the folding of the choanosome; the two regions appear to behave as independent structures. We may imagine their separation to be produced in one of two ways: either an invagination of ectoderm may occur at various points on the surface of the sponge and there initiate the inwardly directed folds, or an actual cleavage may occur along the lines now occupied by the subdermal cavities.

The ectosome in this sponge consists of collenchyma, excavated by a few inconspicuous vesicles, which, on close examination, are found to communicate both with the exterior and the subdermal cavities.

The third young sponge examined (Pl. XVI. fig. 19) measured about 2·0 by 2·6 mm. The subdermal cavities are now well marked off from the incurrent canals, owing to the continued folding of the choanosome; they form an almost continuous cavity about 0·214 to 0·36 mm. thick beneath the ectosome, which is twice as thick as in the preceding stage (0·214 mm.). It consists of collenchyma containing fibre-cells, partly more or less irregularly dispersed, partly forming a thin layer immediately beneath the subepithelial spherasters, and partly arranged as a thin felt over the inner face of the ectosome. This last-named felted layer is the rudiment of the thick fibrous part of the adult cortex.

The vesicular cavities which appear in the ectosome in the preceding stage have now acquired a comparatively large size, and present a striking feature in the young cortex (Pl. XVI. fig. 20). They extend completely across it, and are evidently destined to become the chones of the adult. The cortex is thus formed by the growth and differentiation of a dermal membrane or ectosome, the subcortical cavities are the remains of subdermal cavities, and the chones independent structures, not produced by the original folding of the sponge, but arising subsequently, in connection with the thickening and differentiation of the ectosome.

Subfamily 3. Sanidasterina.

Heterasterose Stellettidæ, in which the additional microsclere is a sanidaster.

Genus 6. *Tribrachium*, Weltner.

Sponge produced into a special cloacal tube, the megascleres of which are orthodiænes. The microscleres are sanidasters.

Tribrachium schmidtii, Weltner (Pl. XVII.; Pl. XLI. fig. 5).

Tribrachion schmidtii, Weltner, Beiträge zur Kenntniss der Spongien., Inaug. Diss. Freiburg, pp. 50–55, Taf. i. fig. 8; Taf. iii. figs. 29–41, 43, 1882.

Sponge (Pl. XVII. fig. 1), somewhat bulb-shaped; consisting of a spherical body and a long, tapering, cylindrical, cloacal tube. In addition to a single terminal oscule opening at the end of the cloacal tube by a sphinctrate aperture, ocular pore-sieves occur generally distributed over the sides of the cloacal tube. Pores small, single, distributed in intercladal areas of the epithelium of the sponge body. Ectosome a cortex.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XVII. fig. 2), fusiform, with sharply pointed ends, 4·9 by 0·0671 mm.; the average length is 4·3 mm.

2. *Somal orthotriæne* (Pl. XVII. fig. 3), rhabdome attenuating to a very finely pointed extremity; cladi conical, sharply pointed or strongylate, diverging at first outwards and forwards, and either gradually curving into horizontality or becoming suddenly bent in the middle of their course; usually bent in the middle in a horizontal plane, or more or less crooked, sometimes one or more cladi are bifurcate; seldom of equal length in the same cladome. Rhabdome 4·3 to 4·9 by 0·087 to 0·095 mm.; cladi of very various dimensions, maximum length 0·475 mm.

3. *Cloacal orthodiæne* (Pl. XVII. fig. 7). This is a reduced orthotriæne; the rhabdome is cylindrical or slightly fusiform, tapering to a sharp point; the cladi diverge outwards and forwards for a very short distance, and then wholly outwards. They are conical, sharply pointed and frequently more or less crooked. The forward direction of the cladi near their origin is shown by the course of the contained axial fibres, but not otherwise indicated except by a concavity lying between them in the middle of the front of the cladome. Rhabdome 3·9 by 0·043 mm. at the origin of cladome, increasing towards the rhabdal origin to 0·0592 mm.; cladi 0·65 by 0·043 mm.

4. *Anatriæne*, often reduced to an anadiæne and anamonæne (Pl. XVII. figs. 4–6); rhabdome conical, attenuating to an almost filiform extremity; cladi variable, usually extending more outwards than backwards, sharply pointed or strongylate. Rhabdome 1·35 by 0·01 mm., cladi 0·0197 to 0·0236 mm. in length, cladus of an anamonæne 0·0355 mm. in length.

II. Microscleres. 5. *Sanidaster* (Pl. XVII. fig. 8), rhabdome straight and slender; cladi numerous, short, with rounded ends; total length 0·012 mm., total width 0·004 mm., rhabdome about 0·001 mm. in diameter.

6. *Oxyaster*. This spicule would appear to be characteristically absent, but a single example, 0·0156 mm. in diameter, was observed in a scleroblastic cell, 0·0185 mm. in diameter.

Colour.—Yellowish-white.

Habitat.—Bahia; shallow water, 7 to 20 fathoms; September 1873. Weltner's

specimen was obtained in Agassiz's expedition of 1879 off Morrolight in 250 to 400 fathoms.

Remarks.—Of this singular and interesting sponge, only the cloacal tube was known to Weltner, who not unnaturally regarded it as a complete organism, although a histological examination would have revealed the absence of choanocytes and flagellated chambers, and thus have suggested its real nature. The specimens of the Challenger collection are fortunately entire, and thus afford an opportunity for complete examination and full description. A longitudinal section through the sponge (Pl. XVII. figs. 9, 10) reveals a cortex sharply differentiated from the choanosome, which is restricted to the spherical body, and does not extend into the cloacal tube. This latter commences in a pointed extremity at the centre of the sponge, where also the spicular fibres of the skeleton originate, thence it gradually enlarges as it proceeds radially outwards, so that within the sponge-body it has the form of an inverted cone, with its base at the periphery and its apex at the centre of the sponge. It is continued outside the sponge-body as an almost cylindrical tube, tapering very gradually towards its distal termination, which is truncated, and closed by a sphincterate diaphragm, centrally perforated by the terminal osculc. The tube is usually slightly curved, with a tendency to be twisted. The following are the dimensions of six of the most perfect specimens in the collection:—(1) spherical body (spongomere) 20 mm. in diameter, cloacal tube, conical basal part 10 mm. long, diameter on emerging from the spongomere 8 mm., length to which it extends beyond the spongomere 65 mm.; (2) spongomere 16 mm. in diameter, cloacal tube 63 mm. long, 6 mm. wide at its point of emergence, 2 mm. wide at its distal termination; (3) spongomere 12 mm. in diameter, cloacal tube 4 mm. wide at its point of emergence, 45 mm. in length; (4) spongomere 11 mm. in diameter, cloacal tube 45 mm. in length; (5) spongomere 8 mm. in diameter, cloacal tube 4 mm. wide at its emergence from the spongomere, 32 mm. in length; (6) spongomere 6 mm. in diameter, cloacal tube 6 mm. long. Besides entire sponges there are a few separate cloacal tubes in the collection; one of these measures 95 mm. in length.

Spongomere—Ectosome.—The cortex is of irregular thickness: in a specimen 8 mm. in diameter it varies from about 0·22 to 0·39 mm. in thickness; it consists of a middle collenchymatous layer about 0·1 to 0·2 mm. thick, faced externally by a thin fibrous layer about 0·002 mm. thick, in which the constituent fusiform cells run parallel to the surface, and continued inwards into a thick layer of fibrous tissue, from about 0·1 to 0·2 mm. thick, in which the fusiform cells arranged in fibres run in various directions, mostly tangentially. The collenchymatous layer, which is widely excavated by intercortical canals, contains, as well as the usual collencytes, numerous fusiform cells, which cross obliquely from the outer to the inner fibrous layer, surround more or less concentrically the intercortical canals, and wander in various other directions; some

fusiform cells, different in character to the others, extend from the collenchyma radially across the outer fibrous layer to end against the investing epithelium.

Choanosome.—The mesoderm, except where it forms the walls of the larger excurrent canals, is a sarcenchyma; about the large canals it is a very typical collenchyma, presenting a colourless unstained matrix and numerous collencytes with long branching processes; it also contains numerous fusiform cells, which are evidently modified collencytes. In the velar diaphragms of the larger excurrent canals one finds displayed in the clearest manner the following structure:—Immediately around the central perforation of the diaphragm is a narrow ring of concentrically arranged fusiform cells, which we may regard as myocytes; surrounding this follows a layer of collenchyma containing numerous fusiform cells, all radiately disposed, and again in some instances surrounding this a thick layer of collenchyma with concentrically arranged fibres. The layer of radiating cells varies in thickness; it is frequently 0·04 mm. across. The cells themselves are very similar in character to myocytes, a slightly different appearance being sometimes produced through the abbreviation or suppression of the outwardly directed filamentous extremity, and sometimes by the conspicuous appearance of the oval vesicular nucleus which bulges out the sides of the cell. In one direction, they end against the epithelium of the velar aperture; in the opposite direction, away from the aperture, they terminate in one or more fibrils which lose themselves amidst the surrounding collenchyma, with the collencytes of which they appear to become continuous. Along with the radiating fusiform cells collencytes are associated with more or less regularly arranged branching processes; thus one process usually runs radiately up to the velar epithelium, two others given off from opposite sides take a concentric direction, and others again are given off from the inner face and extend more or less radiately into the deeper lying collenchyma. This contains a plexus of collencytes and a number of more or less fusiform cells on the whole concentrically arranged.

Ova.—The sarcenchyma contains numerous round or oval cells, consisting of deeply stained granular protoplasm, but without yelk granules, enclosing a spherical nucleus with a spherical deeply stained nucleolus. These cells lie in cavities lined by so-called endothelium; they are of various sizes, the largest seen measured 0·056 mm. in diameter, its nucleus 0·0158 mm., and nucleolus 0·005 mm. in diameter. They are probably ova.

Canal-System.—The pores, 0·025 mm. to 0·06 mm. in diameter on an average, though exceptionally larger, lead into irregular intercortical canals, which communicate through the inner cortical layer with the incurrent canals of the choanosome. These run more or less radially towards the centre of the sponge, interdigitating with the radial branches of the excurrent canals, which originate within the choanosome in circular or oval apertures in the immersed part of the cloacal tube. Thence they extend root-like into the choanosome, running somewhat concentrically within it, but giving off branches which, with their subdivisions, run nearly radially towards the cortex. The flagellated

chambers measure about 0·0316 mm. in diameter; they communicate with the incurrent canals by wide prosopyles or short prosodal canals, and with the excurrent system by aphodal canals of no great length.

Skeleton.—As in other spherical Stellettids the megascleres are arranged in radial fibres proceeding from the centre outwards. Triænes first occur in the choanosome in the immediate vicinity of the cortex; here the cladomes of young anatriænes, and of orthotriænes, now in a protriæne stage, are first seen. The adult triænes extend their cladi within the cortex, at various levels, the orthotriænes mapping out the overlying epithelium into intercladal areas in which the pores are situate. Associated with the outer epithelium, coating its inner surface, a dense layer of sanidasters occurs; less numerously, but still abundantly, these microscleres occur scattered throughout the cortex, particularly below the epithelium of the intercortical canals; within the choanosome they are sparingly distributed.

The Cloacal Tube—Skeleton.—The megascleres of the cloacal tube consist wholly of orthodiænes collected in parallel, more or less equidistant, fibres which extend the whole length of the tube. Each fibre consists of several spicules lying side by side, others overlapping them at the ends, the overlap taking place in such a manner that the cladal end of the one spicule is always exterior to the oxeate end of the other, in other words, the spicules are imbricated with the cladomes outwards. The cladal ends of the spicules are directed distally, the cladomes, lying immediately beneath the outer epithelium and its associated tissue, succeed one another in the same fibre at more or less regular intervals, the cladal centres of succeeding spicules alternating with more or less regularity on each side of a medial line. The cladi of adjacent or pænadjacent[1] fibres are given off at about the same levels, and as each cladus extends across the space between three fibres or even further, the cladi of neighbouring fibres overlap. And further, since the cladi make right angles with the rhabdomes, the foregoing arrangement leads to the formation of a rectangular spicular framework, with interspicular rectangular spaces (Pl. XLI. fig. 5). The regularity of this arrangement is disturbed in various ways; the longitudinal fibres occasionally branch, and the interval between the branch and the main fibre, at first very narrow, increases till it reaches the average; thus not only exceptionally narrow areas are produced, but areas with diverging longitudinal sides. The cladi of adjacent fibres are not always given off at the same level, and thus the interspicular rectangles may become transversely subdivided into two or more of less than the average length.

The spicules are more numerous in each fibre, and the cladi arise at closer intervals as one approaches the origin of the tube; near its distal extremity there may not be more than two or three spicules to a fibre, and the cladi are as often as not separated by intervals of from 0·75 mm. to nearly 1·0 mm., while in the middle of the tube the intercladal intervals are about 0·08 to 0·3 mm. long, and on average about 0·24 mm.

[1] We have "pænultimate," why not "pænadjacent"?

The tissues of the cloacal tube are crowded with sanidasters throughout.

Soft Parts.—A central canal, of much less diameter than the tube itself, from one-half to one-third in a small specimen, traverses it from end to end (Pl. XVII. figs. 15, 18). A collenchymatous wall invested with epithelium on its free surface bounds the canal, and a series of muscular vela or diaphragms of the usual character constrict it at irregular intervals. The collenchymatous wall of the canal is separated by a system of irregular canals or lacunæ from the skeletal wall of the tube, which is also clothed with collenchyma; a connection between the two is afforded, however, by the collenchymatous strands and lamella which bound the lacunar spaces. These freely communicate with the central canal by numerous round or oval apertures in the canal wall (Pl. XVII. figs. 15, 16, 18), which is thereby reduced to a mere sieve-net; in the other direction they open to the external water by sieve-pores in the tissue of the skeletal wall. The exterior of the tube is invested with epithelium and an irregular layer of collenchyma containing numerous fusiform cells, most of which run longitudinally along the sides of the spicular fibres. The collenchyma is thickest about the skeletal framework, but extends thence in fibrous strands across the interspicular rectangles, subdividing them into a number of oval or rounded areas; secondary, smaller fibrous strands frequently proceed from the main strands, and subdivide the larger areas into round or oval fenestræ. The investing epithelium with its associated collenchyma reduced to the thinnest possible layer, where it extends over these, is perforated by round or oval pores from 0·012 to 0·039 mm. in diameter; the number of pores present in a single porous area may vary from one to six, according to the size of the pores and of the area (Pl. XLI. fig. 5).

The sanidasters which underlie the investing epithelium accompany it when it forms the roof of a porous area, but usually not quite up to the margin of the pore; stopping a little short of this they leave the membrane bare; it is apparently structureless, probably consisting of a double epithelial layer only. The pore-sieve structure presented by the cloacal tube is precisely similar to that which serves for the entrance of water into the incurrent system in so many other sponges, and might lead us to question its excurrent function; of this, however, there can be little doubt, since the excurrent canals of the choanosome occupying their usual position, and becoming larger towards the deeper parts of the sponge, can be readily traced into communication with the base of the tube. A similar excurrent structure is also met with in the nearly related sponge *Disyringa dissimilis*, Ridley.

Connection of the Cloacal Tube with the Sponge-body.—The base of the tube, *i.e.*, that part of it within the sponge-body, is surrounded by lacunar spaces, which are bounded on the one hand by the choanosome of the sponge, and on the other by the exterior of the base of the tube; they are thus furnished with collenchymatous walls which are connected across the lacunæ by thick collenchymatous bands (Pl. XVII. fig. 10).

At the point of emergence of the tube the upper and lower fibrous layers of the

cortex approach and unite, forming a single thin layer, which is continued forwards along with the investing epithelium on to the cloacal tube, furnishing the tissue of the skeletal wall. From the lower fibrous layer of the cortex a thin layer of tissue is continued inwards over the base of the tube and another over the adjacent choanosome of the sponge-body, thus furnishing the walls of the lacunar spaces. These layers of tissue are more collenchymatous in character than that from which they are derived. The interior of the base of the cloacal tube is occupied by a mass of collenchyma channelled by numerous excurrent canals.

Development of the Skeleton.—It has already been stated that the cladomes of the orthodiænes become more and more closely crowded together as they are traced towards the base of the cloacal tube. This approximation is continued as the tube enters the sponge, and is accompanied by a decrease in size, till only very small and early forms are reached. These small spicules lie within the collenchyma of the base of the tube arranged in vertical radial planes, one behind the other, the youngest situated most externally, and successively older forms occurring towards the interior. This is well shown in transverse sections made at the proper level through the sponge (Pl. XVII. fig. 14). The spicules cross the wall of the tube from within outwards obliquely, the cladomes cropping out at its surface one above another, the lowest lying being the youngest. Looked at from the outside the cladomes and cladal ends of the rhabdomes form a structure over the base of the tube like finely woven basket-work (Pl. XVII. fig. 11). Evidently these spicular series are modified radial fibres, adapted to the sides of the cloacal tubes.

The chief interest in these spicules is centred in their mode of development. Weltner has enquired whether they are to be regarded as primitive forms or reduced triænes, and the following observations furnish a conclusive answer to that question. The earliest form of spicule, as shown both by its characters and position, is a minute oxea, 0·071 mm. long by less than 0·002 mm. in width ; the distal end appears to be less sharply pointed than the other. In the next stage observed we meet with an oxytylote, already developing minute cladi ; the rhabdome, finely pointed at the oxeate end, measures 0·142 by 0·002 mm.; at the tylote end it is thickened into a small bulb 0·004 mm. long by 0·003 mm. in width, from which at the border of the summit minute conical spines extend outwards and forwards. The number of spines could not be ascertained, owing to the position of the spicule. In the next stage, one more frequently observed, the rhabdome has attained a length of 0·275 mm. by 0·0025 mm. in diameter. It tapers to a finely pointed oxeate end, beyond which the axial fibre protrudes, bare of its siliceous investment, apparently into the surrounding collenchyma, but in reality more probably into the scleroblast. The tylote thickening is about 0·004 mm. in diameter, and three small cladi, two of which are about 0·0118 mm. in length, project from it. A spicule in this stage is represented in the figure (Pl. XVII. fig. 12). A stage later and the tylus

has increased to 0·008 mm. in diameter, two of the cladi are 0·0236 mm. in length, and the third, 0·004 mm. long, appears merely as a rounded tubercle. In succeeding stages the tylus and cladi increase in size: but the rhabdome grows so much more rapidly than the tylus, that eventually it becomes of the same thickness, and the distinction between the two, though it persists for some time, is finally obliterated. In a spicule with the rhabdome 0·0118 mm., the tylus is 0·0158 mm. in diameter, and the axial fibre of the third and shortest cladus is traceable into it for a distance of 0·0075 mm. The axial fibre of this third cladus, which in the adult spicule is usually entirely suppressed, can be traced for a long distance through the spicular series, indications of it persisting in some cases in spicules with a rhabdome 0·039 mm. in diameter, and therefore presumably almost adult: in this case it is represented by its axial fibre, which is about 0·0035 mm. in length. The two persistent cladi of the young spicules do not lie nearly in the same plane with the rhabdome, *i.e.*, at about 180° with each other, but diverge at an angle which is more nearly 120° than that.

Having shown that the adult diæne originates in a triæne form, and that in all probability in an oxytylote, which is descended in turn from an oxea, we may next turn to enquire into the cause of the suppression of the third cladus of the triæne. This appears to be traceable to pressure. The suppressed or arrested cladus, in the early stages of development of the spicule, is pressed against the rhabdome of the spicule next behind it in the series (Pl. XVII. fig. 12), and, considering the sensitiveness of more fully grown spicules to the slightest action of pressure, it is no wonder that a young cladus so unfavourably situated should suffer an early arrest of development. To a similar cause in all probability the suppression of one or more cladi of the anatriænes of the sponge-body is due.

The scleroblasts of the megascleres are well displayed in several preparations of this sponge. The characteristically large nucleus of the spicule-cell is situated at about the middle of the oxeate spicules, just over what we may presume is the position of the actinal origin. In the triænes it always occurs nearer the cladal than the oxeate end. In a young orthotriæne of the sponge-body the distance of the nucleus from the cladal origin measures 0·146 mm., and from the oxeate termination 0·288 mm.; in a more fully grown form these distances become 0·592 and 1·203 mm.; in an anatriæne they are 0·217 and 0·414 mm. In these three cases the distance of the nucleus from the cladal origin is about one-third the total length of the spicule, and if we suppose the actinal centre corresponds, as appears very probable, with the position of the scleroblastic nucleus, we may express this fact in the statement that the length of the cladal actine is to that of the acladal actine as 1 : 2.

Thus a kind of balance appears to exist between the two actines, the oxeate actine compensating by its greater length for the greater thickness and the branches of the cladal actine. As a notion seems to exist that this may be the case, Carter often

remarking that what a spicule gains in breadth it loses in length, I thought it might be worth while to calculate the volume of the two actines, on the assumption that the actinal origin in all cases is situated one-third the length of the rhabdome from the cladal origin, an assumption which so far is based on far too few observations to be of great weight. An orthotriæne was selected having the following dimensions:—Rhabdome 3·84 mm. in length by 0·0839 mm. in diameter just below the cladal origin, and 0·055 mm. in diameter at a distance one-third the length of the rhabdome from the cladal origin; average dimensions of the three cladi, each 0·318 by 0·0839 mm. A rough calculation gives 0·0196 cubic mm. for the volume of the cladal actine without the cladi, and 0·0081 c.mm. for that of the oxeate actine, so that, leaving the volume of the cladi out of consideration, the cladal actine without the cladi by itself has twice the volume of the other. The volume of the cladi is about 0·0074 c.mm., almost equal to that of the oxeate actine. In order in this case that the two actines should have equal volumes the actinal centre should be situated about one-sixth of the entire length of the rhabdome from the cladal origin. This is inconsistent with the assumption on which we started; but it is not altogether opposed to observation, since in some Stellettids the scleroblastic nucleus has been observed in a position almost corresponding to this.

Genus 7. *Disyringa*,[1] n. gen.

Sponge more or less spherical, produced at one pole into a special poral or incurrent tube, and at the other into a special cloacal or excurrent tube. The chief canals of both systems symmetrically arranged, alternating with each other on a tetragonal plan. The microscleres in addition to euasters are sanidasters and orthodragmas.

Disyringa dissimilis (Ridley) (Pl. XVIII.; Pl. XLI. figs. 1–4).

Tethyopsis dissimilis, Ridley, Voyage of the "Alert," p. 447, pl. xl. fig. H, and pl. xliii. figs. *l*–*l'*.

Sponge (Pl. XLI. figs. 1–3; Pl. XVIII. figs. 1–3), free, spherical, produced at one pole into a long cylindrical excurrent tube terminating in a thin, solid, obtusely conical disc, and at the opposite pole into a long, cylindrical, incurrent tube, the end of which is not preserved. Surface even, apparently smooth but rough to touch. Pores confined to the walls of the poral or incurrent tube.

Spicules.—I. Megascleres. 1. *Somal oxea* (Pl. XVIII. fig. 10), fusiform, straight, or more usually gently curved, variously pointed, sharply or obtusely, or pencil-like; 4·641 by 0·0592 mm.

2. *Cortical oxea*, similar to the preceding but smaller, 1·785 by 0·135 mm.

[1] σύριγξ,—ιγγος, ἡ, Pan's pipe hence anything in shape like a pipe.

3. *Cladoxeas* (Pl. XVIII. figs. 4–9), of various forms.

A. Of the body of the sponge.

α. Orthotriæne, a conical, sharply pointed rhabdome, with conical, sharply pointed cladi, at first diverging outwards and forwards, but mostly outwards, and afterwards horizontally. Rhabdome 3·6 by 0·05 mm., cladi 0·47 mm. long.

β. Orthodiæne (Pl. XVIII. fig. 8), similar, but with one cladus aborted.

γ. Orthomonæne (Pl. XVIII. fig. 9), similar, but with two cladi aborted. Rhabdome 3·75 by 0·075 mm., cladus 0·535 by 0·055 mm. This is by far the commonest form.

B. Of the excurrent tube.

α. Orthodiæne, an orthotriæne with one cladus aborted, the remaining two sometimes equal, oftener unequal in length; when equal about 1·0 mm. in length, or longer or shorter according to the diameter of the tube which they support.

β. Orthomonæne (Pl. XVIII. fig. 4), similar, but with a second cladus aborted, or reduced to a tubercle, and the third much developed, attaining a length of 1·143 mm.

γ. Dichomonæne (Pl. XVIII. fig. 6), similar to *β*, but with the remaining cladus bifurcated, one of the deuterocladi being large and the other scarcely more than a tubercle. Rhabdome 5·533 by 0·05 mm.; relative lengths of protocladi and deuterocladi very variable; the protocladus frequently 1·0 mm., the large deuterocladus 0·7 mm., the reduced deuterocladus 0·07 mm. long.

The measurements of these spicules are taken from examples obtained from an excurrent tube about 5 mm. in diameter, belonging to a sponge about 20 mm. in diameter. In a tube of about twice the diameter of the preceding, the cladi of the spicules are frequently much longer, *e.g.*, 2·142 mm., with about the same thickness.

II. Microscleres. 4. *Oxyaster* (Pl. XVIII. fig. 12), minute, with a comparatively large centrum, and numerous slender, sharply pointed actines; 0·008 to 0·0118 mm. in diameter.

5. *Sanidaster* (Pl. XVIII. fig. 11), similar in form to that of *Tribrachium schmidtii*, but larger; 0·01185 to 0·0158 mm. long.

6. *Orthodragma* (Pl. XVIII. fig. 13), chiefly confined to the oscular tube; of the usual characters; 0·0237 to 0·0276 mm. by 0·0118 mm.

Colour.—Translucent greyish-white, choanosome opaque yellowish-white.

Habitat.—Torres Strait, August 1874; depth, 3 to 11 fathoms.

Station 188, Arafura Sea, south of Papua, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; depth, 28 fathoms; bottom, green mud.

Also (Ridley) Port Darwin, 7 to 12 fathoms; bottom, sand and mud; and Torres Strait, 10 fathoms; bottom, sand.

Remarks.—As one of the most remarkable sponges, if not the most remarkable, of the Tetractinellid collection, this species merits a detailed description. The first

specimens which came into my hands consisted simply of the broken-off excurrent tube—the same part of the sponge that served for Mr. Ridley's description of the species. On similar fragments of an allied species (from the description I can hardly suppose it to be the same) Marshall's account of *Agelardiella radiata* was based. After making both longitudinal and transverse sections through the tube, I searched diligently in the prepared slices for flagellated chambers, and though at first surprised at not finding any in a specimen with evidently well-preserved tissues, I finally concluded that the tube was not the whole sponge, and that the part containing the choanosome was missing. Under this impression the figure of one of the cloacal tubes (Pl. XVIII. fig. 2) was represented upside down, the conical disc having been regarded as a part of the cortex torn away from the sponge-body, while as we now know it really forms the free distal termination of the excurrent tube. All doubts as to the existence of a sponge-body were subsequently set at rest by a fragmentary specimen which I long afterwards received, and which is represented on Pl. XVIII. fig. 3. Finally, when this Report was well-nigh concluded, a collection of almost perfect specimens came into my hands, showing not only the excurrent tube, but an incurrent conduit as well, a totally new and unexpected feature, and possibly unique amongst the sponges as a group. Unfortunately no specimen I have yet seen is complete from the beginning of the incurrent to the end of the excurrent tube; in all, the excurrent tubes are broken off some distance apparently from the end; on the other hand, numerous fragments of excurrent canals occur terminated by the conical disc, so that in fact all parts of the sponge are known, and thus we are enabled to construct the restoration shown in Pl. XLI. fig. 2.

A median longitudinal section of the sponge passing through both excurrent and incurrent tubes reveals the following structure (Pl. XLI. fig. 3):—In the sponge-body a central yellowish-grey opaque choanosome, surrounded by a translucent bluish-grey ectosome or cortex. In the centre of the choanosome is a dense white spicular nucleus from which spicular sheaves radiate towards the cortex and to both tubes; at the base of the incurrent conduit they stop short, but those proceeding to the excurrent tube are continued into it, passing up its centre and along its sides to constitute the cloacal skeleton. The cortex is produced at each pole to form the outer wall of each tube. The excurrent canals of the excurrent tube can be traced into the choanosome of the sponge, where they ramify in the usual manner; the single canal of the incurrent tube is subdivided where it reaches the cortex into four large branches, which enter the cortex; these are visible not only in sections, both longitudinal and transverse, but they can be traced like blue veins beneath the skin in whole specimens (Pl. XLI. fig. 2); after proceeding some short distance they each bifurcate, and the diverging canals so produced again bifurcate, and finally subdivide into branches too small to be traced by a simple lens. Subsidiary canals are also given off above and below the main bifurcations.

An examination of the superficial layer of the cortex failed to reveal the presence of

open pores in the epithelium; though it forms the roof to numerous dome-like canals extending up to it. It is, of course, quite possible that pores may open in this epithelial roof when the sponge is actively alive, and that they close up when it is exposed to unfavourable conditions, such as immersion in alcohol. However this may be (and I think it unlikely) the chief supply of water to the sponge evidently flows through the incurrent tube, which delivers it to the intercortical cavities or superficial branches of the incurrent canals; thence it descends by the usual incurrent canals into the choanosome, and is urged on by the choanocytes through the flagellated chambers into the excurrent canals, whence it flows into the cloacal tube, and by pores in the walls of this reaches the exterior.

The Cortex.—The exterior of the whole sponge is invested with an epithelial layer, over the under face of which are scattered innumerable sanidasters; this then forms the outermost layer of the cortex. It is succeeded by collenchyma, which presents the usual stellate collencytes, but with the branching processes strongly developed, so as to produce a general fibrous reticulation. In addition numerous fusiform cells are present, most, but not all, of which are gathered into fibrous tracts, which wrap round the spicules of the cortex, binding them together into a strong framework. Next the choanosome the fibres are more richly developed than elsewhere, forming a darkly staining layer. Immediately beneath the epithelium is a layer of collencytes more or less fusiform in shape, their long axes lying radially, with short processes extending from their distal ends at right angles to the epithelium, with which they come in contact, and longer processes from their proximal ends descending into the collenchyma. The cortex is densely crowded with oxeas (No. 2), which lie chiefly horizontally in all azimuths; it also receives the ends of the radiating sheaves of the chief skeleton (Pl. XVIII. fig. 14). These include both oxeas and cladoxeas, the latter chiefly orthomonænes (3, γ), their single cladi projecting into the cortex away from the side of the sheaf, in the same manner as the corresponding spicules do in *Chrotella macellata*, among the Tetillidæ (see p. 20).

Numerous irregular canals traverse the cortex, apparently in all directions, without any tendency to a chonal arrangement. According to universal rule they are lined by epithelium, which is accompanied by the usual sanidasters. The cortex is about 0·0714 to 1·0 mm. thick.

The Choanosome.—The mesoderm of the choanosome is a sarcenchyma, richly provided with fusiform cells, which are arranged about the spicular sheaves, both longitudinally and transversely, the transverse fibres enveloping the spicules and binding them together. Fibres cross from one spicular sheaf to another, concentrically surround the water canals, and wander apparently aimlessly among the flagellated chambers, which are frequently circumscribed in groups by fibrous strands. The flagellated chambers (Pl. XVIII. figs. 16, 22) measure 0·0276 mm. in breadth, by 0·0237 mm. in length, the apopyle is about

0·008 mm. wide, and the prosodus very short. The choanocytes present no unusual characters.

The Incurrent Conduit (*Conditus*).—The cortex is continued into the wall of the conditus, which may be regarded as a tubular extension of the cortex (Pl. XLI. figs. 3*b*, *c*). It is a simple open tube, undivided either by transverse or longitudinal diaphragms. The radiating spicular sheaves of the body extend up to its base, but do not proceed further, the spicules which support its walls being similar to the oxeas of the cortex, arranged longitudinally and transversely parallel to the surface. The wall, at first thick and rigid, soon becomes thin and very flexible; and is perforated by poral canals which lie in the rectangular interspaces sketched out by the underlying transverse and longitudinal oxeas. The external epithelium with its associated sanidasters can be traced down the sides of the poral canals into continuity with the epithelium, also incrusted with sanidasters, which lines the inner surface of the tube. The tissue composing the thickness of the wall is collenchyma traversed by longitudinal, parallel-sided, thin bands of fusiform cells, which run continuously for a considerable distance; in a preparation 3 to 4 mm. long some of the bands could be individually traced from end to end, maintaining the same breadth, and only ceasing with the preparation. It is very unfortunate that the natural termination of the conditus is not preserved, as sense-cells might be expected to occur in it.

The only spicules of the conditus are oxeas and sanidasters.

The Cloacal Tube.—This is cylindrical, tapering, polygonal or circular in transverse section, terminated distally by a conical disc. It is composite, consisting of from four to fifteen (normally sixteen) contiguous, longitudinal, cylindrical tubes, which extend throughout its whole length, taking a slightly spiral direction, to the extent of twisting through an angle of about 180° between the two extremities. The component tubes are circular, oval, or triangular in section; they are arranged in tetragonal symmetry. *Stage of four component canals* (Pl. XLI. fig. 3, *a*; Pl. XVIII. fig. 15).—When only four tubes are present, they are so disposed that tangents drawn common to them in pairs would form a square; they touch each other in two places, leaving a curved quadrangular area in the middle; this is sometimes occupied by a spicular axis, which is easily parted in the middle, leaving a vacant space, or the spicular axis may not be present, and its space is left void; in either case a deceptive appearance, as that of a fifth and central canal, is present; it is possible that the central canal represented by Marshall in *Agilardiella*[1] and by Ridley (pl. xliii. fig. *l'*, *loc. cit.*) is to be thus explained. When the cloaca formed of four tubes has a quadrangular section, each side is formed by the external part of the wall of one of these tubes, which then have the form of an equilateral triangle with a curved base facing outwards. *Stage of eight canals.*—Ridley figures a cloacal tube composed of nine canals; if, however, the central one be disregarded, this would give us a stage of eight such as

[1] *Abhandl. d. k. Akad. d. Wiss. Berlin* for 1883, fig. 7.

might, from the general structure of the tube, have been expected. Of these eight, four are primary, arranged as described in the stage of four, the remaining four are smaller secondary tubes, they lie in the outer angles of the four primaries, one between each pair of these. *Stage of ten canals.*—Ridley also figures a stage of ten, in which the four primary have the usual arrangement, but there are only two secondaries, one at each end of an axis of symmetry passing between the pairs of primaries; the remaining four canals are of the third order (tertiaries), and occupy the outer angles between the primaries and secondaries. *Stage of sixteen canals* (Pl. XVIII. figs. 1, 18, 19).—In the largest cloacal tube in the Challenger collection is a stage of fifteen (sixteen, with one tube, required to complete the symmetry, suppressed), the four primary tubes (I., fig. 18) have the usual arrangement, then follow four secondaries (II., fig. 18), situated in the outer angles formed by contiguous pairs of primaries, and finally seven (8 – 1) tertiaries (III., fig. 18) are present, situated each in the outer angle between a primary and secondary canal. The eighth required for complete symmetry is altogether absent, not being represented even by a rudiment; the basal part of the tube, however, is not present, or possibly a trace of the missing canal might be found near its proximal end. In *Agilardiella*, Marshall represents a stage of eight, in which all the tubes are of the same value, *i.e.*, primaries.

Proximally the cloacal tube is traceable into continuity with the cortex and choanosome; the main excurrent canals of the latter are continued as the component tubes of the cloaca, and its radiating spicular sheaves are continued into the skeleton of these tubes.

The spicular sheaves which approach the cloacal tube differ from the rest which enter the cortex, their cladomes are developed earlier, so that the young triænes are found quite close to the spicular nucleus, and from the earliest developed cladomes of these a regular series of growing forms succeed till the cloacal tube is reached and entered. The arrangement of these spicules is similar to that already described in *Tribrachium* (p. 157); but as there are at least four tubes present in the cloaca of *Tethyopsis*, and never more than one in *Tribrachium*, so in the former case the spicules are more numerous; in the latter the young spicules of the tube could be traced into connection with an inflexion of the cortex; in the former nothing of the kind is to be observed, the spicules destined to enter the cloaca lying entirely within the choanosome.

The youngest form of the cloacal cladoxea closely resembles that of the orthodiæne of *Tribrachium;* there is indeed no discernible difference, except in the absence of a rudimentary third cladus, which I could not find, owing probably to the fact that I did not employ all the means of research available. Having found the rudiment in *Tribrachium*, there was less necessity to do so in this case. The young spicules observed are not only like those of *Tribrachium*, but, except for the absence of a third cladus, precisely similar to those of normal Stellettidæ, the differences which distinguish the adult spicule being due to subsequent excess and defect of development.

On entering the cloacal tube the oxeas and cladoxeas extend longitudinally through the walls of the component canals in bundles, which chiefly occur in the angles between the canals. The long cladi of the cladoxeas, extending from them at right angles, are curved so as to encircle the canal of which they form the skeleton for about one-half of its circumference. As the history of the cladi of these spicules can be traced with tolerable clearness, it may be as well to introduce an account of it in this place. Let *a*, *b*, *c*, (Fig. 1A) be the three cladi of a normal orthotriæne seen in plan. In the cloacal tube the spicule is so placed that the cladus *a* has opposed to it the rhabdome of the next succeeding spicule of the bundle; it therefore becomes suppressed; the cladus *b* projects into the collenchyma of the canal, which is present only in thin lamellæ;

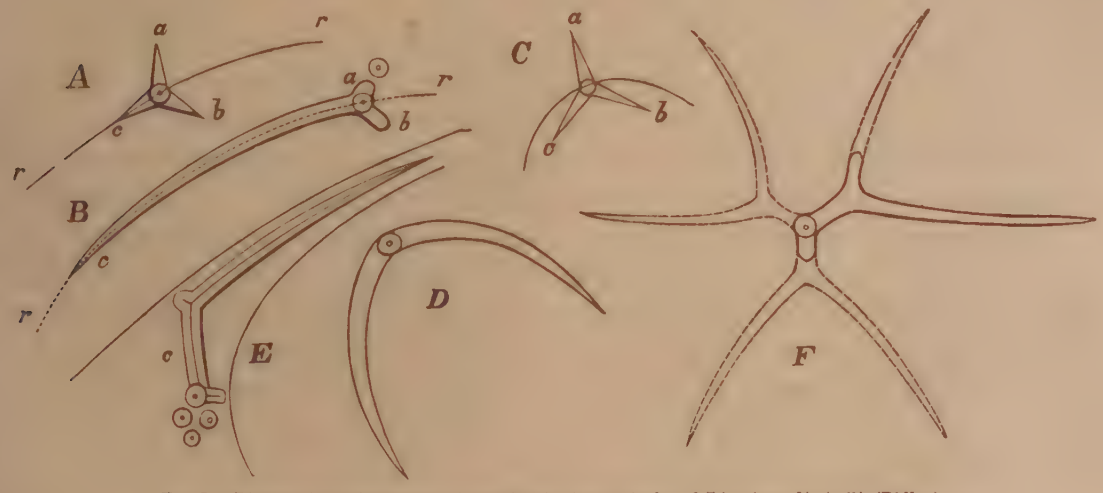


FIG. 1.—Diagram in explanation of the modified triæne spicules of *Disyringa dissimilis* (Ridley).

as soon as it reaches the limits of a lamella its growth is arrested by default of supporting tissue, and it remains a mere tubercle; the cladus *c*, on the other hand, lies in the circumference of the wall of the canal *r*, *r*, its growth can take place unimpeded, and it does not cease increasing in size till it has half encircled the canal (Fig. 1B).

Again the spicule may be so situated (Fig. 1C) that both cladi *b* and *c* lie in the direction of the circumference of the canal, both these may enlarge (Fig. 1D), though as one is usually more favourably situated than the other their growth is unequal. Dichodiænes are produced as follows:—They occur in the spicular bundles which lie closest to the exterior of the cloacal tube; the long cladus *c* follows the wall of the canal to which it belongs (Fig. 1E), but as this suddenly changes from a curve of less radius to one of much greater radius on leaving the interior to form part of the external boundary of the cloacal tube, so the spicular cladus changes direction with it and thus becomes bent. In this way spicules

with long bent cladi arise. But it is a rule amongst sponges that bending is a precursor to budding or bifurcating; a bud thus arises at the point of flexure, and a bifurcate cladus is the result (Fig. 1E). Thus the various forms of triænes which characterise this sponge may be explained as special modifications produced by the special mechanical conditions involved in the structure of the cloacal tube. The diænes with a single bifurcate cladus might be regarded as reduced forms derived from dichotriænes like those of *Thenea*. Thus let the figure (Fig. 1F) represent the cladome of a dichotriæne seen in plan; if all the cladi except those shown by heavy lines be suppressed we shall obtain the diæne of *Tethyopsis*. I by no means deny the possibility of such an origin, but regard it at the same time as less probable, for not only do the conjecturally least modified triænes of the cortex present no trace of bifurcation, but in *Tribrachium*, the nearest ally of this sponge, they are similarly absent. (Since writing this I find however that dichotriænes are sometimes present in *Tribrachium* in the cortex near the base of the cloacal tube, and so far the probabilities in favour of a dichotriæne origin of the diænes are increased.) Moreover, they are confined in the sponge under consideration to special regions, and are exactly adapted to the circumstances under which they there occur; the point of bifurcation of the cladus is invariably situated at the point of rapid flexure of the circumference of the excurrent canal, and the relative lengths of the proto- and deuterocladi alter according to the distance of this point from the cladal origin. Finally, a whole series of gradations can be traced between the usual monæne and the diæne with one dichocladus. The importance of this contention is obvious, for if the conclusions here reached be held correct, we have additional evidence in favour of the origin of similar forms of spicules, and by equal reason of other structures, from different ancestors, but under similar mechanical conditions.

Besides cladoxeas, oxeas are present in cloacal tubes of the stage of four, but not in that of sixteen (fifteen); they lie in the walls of the excurrent tubes longitudinally, and where these tubes form the outer wall of the cloacal tube, they lie both longitudinally and transversely, parallel to the surface, like those of the incurrent conditus.

The lumen or canal of the excurrent tubes is much narrower than the spicular wall, within which it lies more or less concentrically (Pl. XVIII. figs. 18, 19). The face of this canal is lined with epithelium and its sanidasters, and between it and the collenchymatous layer of the spicular wall run connecting strands and fenestrated lamellæ of collenchyma coated with epithelium, beneath which sanidasters occur, but less densely than usual; on the other hand additional spicular elements, the orthodragmas, make their appearance within the collenchyma. The collenchymatous strands and lamella are so disposed, radiating between the inner and outer walls of the canals, curving, branching and anastomosing, as to subdivide the intervening space into widely communicating more or less vesicular lacunæ. The collenchyma of the spicular wall also is fenestrated, so

that the lacunæ of one canal are in communication with those of that adjoining. Numerous fusiform cells are present in the collenchyma as well as the usual branched collencytes, and large round or oval vesicular cells occur as well. These cells (Pl. XVIII. figs. 20, 21), which vary in abundance, sometimes lying so close together that they touch, are about 0·04 mm. in diameter, with a very definite outer wall, appearing in optical section as a thin double-contoured line; circular when seen face on; and, since they are much depressed, oval when seen in transverse section. Their thickness as shown in such sections is about 0·015 mm. Excentrically situated is a small circular nucleus, 0·005 mm. in diameter, containing a small spherical nucleolus, and surrounded with a small irregular heap of granular protoplasm, from which irregular, branching, and often anastomosing granular threads extend to the outer wall, within and over which they expand into a continuous, granular, protoplasmic layer. These cells lie close to the epithelium of the lamella within which they occur, in a single layer facing the surface; occasionally the layer may become double.

The fusiform cells, often over 0·296 mm. long, are variously arranged: some run radially through collenchyma from the spicular wall to the inner wall of the canals, entering a layer of concentrically arranged fibres with which the inner wall is surrounded. At varying intervals (Pl. XVIII. fig. 17), on an average about 2 mm. apart, the lumen of the canal is crossed by a membranous diaphragm (homologous with the usual velum of the water canals), centrally perforated; around this perforation dark gray, highly granular, fusiform cells are concentrically arranged, forming a powerful sphincter.

The spicular fibres are encircled by sheaths of concentric fibres, and similar fibres wrap round individual spicules; the spicules also serve as points of attachment for the fibres which radiate through the collenchyma; when these fibres pass on to the spicules they appear to expand into a finely fibrillated film; between the filmy ends of adjacent fibres, large oval cells with granular protoplasmic contents are developed close to the sides of the spicules (Pl. XVIII. fig. 24); the meaning of this arrangement is not obvious, as the cells do not appear to be scleroblasts. Between the spicular columns, running parallel with them longitudinally, are strong fibres about 0·04 mm. thick, composed of fusiform cells, which on reaching the distal disc of the cloacal tube enter it divergently, and radiate towards its margin and surface, terminating partly by enveloping the spicules of the disc, partly by entering a fibrous layer which coats its distal face.

The outer wall (Pl. XVIII. fig. 20) of the cloacal tube consists of a collenchymatous layer faced with epithelium on both sides, and continued on the inner face into the strands and lamellæ of collenchyma before mentioned. Parallel longitudinal fibres of fusiform cells traverse it, bulging it on the inner side; they are about 0·028 mm. wide, and on an average lie about 0·08 mm. apart. The outer wall is thus ruled out, as it were, into a number of longitudinal strips separated by the fibrous tracts; beneath these strips lie the lacunæ of the canals. Transverse thickenings of collenchyma, containing trans-

verse fibres, which lie deeper than the longitudinal tracts, cross these at intervals, subdividing them into a number of oval areas, the thin roofs of which are perforated by one or more pores (Pl. XVIII. fig. 2). The external poriferous wall of the cloacal tube extends on to the under surface of the conical plate which distally closes it.

This plate is formed by a trumpet-like expansion of the axial columns of cloacal cladoxeas with their associated tissues, covered externally by a similar expansion of the outer wall, as just mentioned. Its distal face and margin are hispidated by radiating, slender, oxeate spicules which project as far as 5 mm. beyond it.

In the large cloacal tube (stage of sixteen) it is absent, and a thin poriferous membrane, at the end of one canal perforated by an oscule, alone closes the distal ends of the excurrent tubes. The absence of the disc appears to be the result of some injury which the sponge sustained during life.

The plate is composed of collenchyma, supported by monaenes, the cladi of which lie radiately parallel with the distal face which they support. It is invested with the epithelium and associated sanidasters which are present over the whole free surface of the sponge. Its substance is excavated by numerous vesicular spaces which are in direct communication with the canals of the excurrent tubes; those vesicles which lie immediately beneath the membrane covering the distal end of the disc appear to communicate with the exterior by a few pores. The poriferous membrane of the under or proximal surface of the disc is not traversed by longitudinal fibres of fusiform cells like those of the wall of the cloacal tube. The epithelial margin of each pore, from 0·0118 to 0·0276 mm. wide, is bare of sanidasters for about 0·004 to 0·008 mm.; they then set in and mark out a framework with rounded meshes, within each of which a single pore, or may be two pores, are situated. The width of the bars of this framework is about 0·016 to 0·02 mm., so that the pores lie very close together.

Relation of the Incurrent to the Excurrent Canals.—If the incurrent canals of a sponge are to be regarded as the outer sinuses, and the excurrent canals as the corresponding inner sinuses, of the folds of a folded choanosomal plate, it follows that for every excurrent canal there must exist a corresponding incurrent canal, and further, that the two kinds of canals must be alternately arranged with respect to each other. In the present instance, where both the excurrent and incurrent canals are symmetrically arranged, we are provided with an exceptionally excellent opportunity of determining whether this relation actually exists; and a mere inspection of such a specimen as is shown in the illustration suffices to show that it does (Pl. XLI. figs. 3*a*, *c*), the four excurrent canals at one pole being alternately arranged with respect to the four incurrent at the other. Here, however, the two sets of canals are separated from each other by the intervening sponge-body; if, however, we cut the sponge-body across transversely, we may expect to find both sets of canals present in the same section; such a section is represented in the illustration (Pl. XLI. fig. 4), and it will be seen that the alternate

arrangement which theory predicts is exactly maintained. We may therefore regard the canal system in this sponge as produced by a regular symmetrical longitudinal folding of a more or less spherical Rhagon, followed by an outgrowth at the oscular and ant-oscular poles of special excurrent and incurrent tubes. Since the symmetrical arrangement occurs in an exceptional and remarkably specialised form of Stellettid, and no trace of symmetry is present in the more normal and less specialised species, it cannot be regarded as of any phylogenetic significance.

Genus 8. *Stryphnus*,[1] Sollas.

The somal megascleres are colossal oxeas, closely strewn through the sponge, not aggregated to form fibres and not radiately arranged. The ectosomal megascleres include ortho-, plagio-, or dicho-triænes. The microscleres are some form of euaster and an irregular amphiaster or sanidaster. The ectosome is composed of collenchyma densely crowded with megascleres.

Stryphnus niger, Sollas (Pl. XIX.).

Stryphnus niger, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 193, 1886.

Sponge (Pl. XIX. fig. 1), compound, massive, growing from a wide base into erect lobes and an erect winding wall-like plate of unequal height, and with a rounded margin. Oscules large, collected in groups on the summit of the wall, and on projections from its sides, and the sides of the lobes; incurrent canals large, descending from the oscules vertical to the surface. Pores singly distributed. Cortex thick, collenchymatous, oxeas distributed through it, in both tangential and radial directions. Surface even, but rough to the touch.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XIX. fig. 2); large, stout, fusiform, usually curved, variously pointed—obtusely, sharply, or rounded off; 2·38 by 0·061 mm.

2. *Dichotriæne* (Pl. XIX. figs. 3, 6), small; rhabdome conical, obtusely pointed; protocladi projecting chiefly outwards, very slightly forwards, deuterocladi horizontal. Rhabdome 0·446 by 0·0356 mm., protocladi 0·055 mm., deuterocladi 0·079 mm. long, chord 0·254 mm.

II. Microscleres. 3. *Oxyaster* (Pl. XIX. figs. 5, 8), a very small centrum and numerous slender, conical, sharply pointed actines; a single actine measures 0·014 mm. in length.

4. *Amphiaster* (Pl. XIX. fig. 9), various in form and size; typically a straight, short, cylindrical axis, with a whorl of spines at each end; occasionally the shaft terminates in sharp points, and the spines also are conical and sharply pointed; most usually the ends

[1] στρυφνός, harsh, rough; in allusion to the roughness produced by the irregularly and loosely aggregated oxeas, whether hispidating the surface or projecting from a broken face of the sponge.

of the shaft are rounded off, and the spines reduced to short stumpy rods or elongated tubercles; the middle of the shaft is usually smooth and free from spines, but sometimes spines are produced from it at a great number of points; the whorls then disappear and a generally tuberculated irregular mass results. The commonest dimensions are 0·0158 by 0·0118 mm. (including the spines); these are sometimes however exceeded, the length sometimes reaching 0·0198 mm.

Colour.—A deep puce-black externally, grey within.

Habitat.—Off Port Jackson, June 3, 1874; depth, 30 to 35 fathoms.

Remarks.—There is a single large specimen of this sponge overgrown by a large *Gelliodes* (*Gelliodes poculum*, Ridley and Dendy). The irregularly winding flattened base is about 150 mm. in length by 80 mm. in width; the wall-like mass of the sponge is about 18 mm. in thickness and 122 mm. in height; the oscules attain a diameter of 3 mm.

Ectosome.—This varies in thickness from 1·75 to 3·0 mm. (Pl. XIX. fig. 10). Beneath the outer epithelium (Pl. XIX. fig. 11) is a very thin deeply stained layer, about 0·02 mm. in thickness, crowded with amphiasters and containing numerous fusiform cells tangentially arranged. This passes into the main ectosomal tissue, which consists of collenchyma containing large thin-walled cells in such numbers as to constitute by far the larger part of the tissue. These cells (Pl. XIX. figs. 16–19) are round or oval in outline, and usually about 0·044 by 0·036 mm. in length and breadth; within the thin membranous wall is a finely meshed network of thin protoplasmic films and threads, surrounding a small, more or less central, nucleus, about 0·005 mm. in diameter, which contains a small, deeply stained, spherical nucleolus. The nucleus is supported by protoplasmic threads which radiate from it and extend into the general network (fig. 17). The network varies in character in different cells; sometimes small accumulations of deeply stained protoplasm occur at the nodes, and the whole terminates in a thin peripheral film lining the outer wall. Sometimes the network is contracted into a small central mass surrounding the nucleus at some distance from the outer wall (fig. 18); sometimes, again, small, pale, scarcely visible bodies, of circular outline and about·0·004 mm. in diameter, are thickly scattered through the network.

Associated with these cells are others (Pl. XIX. figs. 11, 20) on which the dark colour of the sponge depends. They are of the same size and shape as the foregoing, and are similarly provided with a thin membranous outer wall, but in place of a protoplasmic network they contain a number of spherical, sepia-coloured bodies, about 0·003 to 0·005 mm. in diameter, which are frequently closely packed together so as to completely fill the cellular envelope. By careful focussing these spherical bodies are resolved into a dark coloured external wall enclosing a clear central space, within which again a small dark, almost black, spherule occurs. In the process of cutting thin slices of the sponge

more or fewer of the spherical bodies are usually torn out of the cell, and those which remain are separated by clear intervals from each other; it then becomes evident that as a rule no network of protoplasm is associated with these bodies, they alone constitute the contents of the cell.

It is evident that some kind of relation exists between these pigment-cells and the cells previously described, and this is rendered certain by the occurrence in the latter of occasional spherical bodies of the same character as those of the pigment-cells (Pl. XIX. fig. 21). The question then arises as to whether the pigment-cell is a metamorphosed protoplasmic network cell, or whether the latter is an exhausted pigment-cell. The latter would appear to be the more probable view; the pale circular bodies of the protoplasmic cells have much the appearance of pigment spherules which have lost their pigment. They frequently contain a small body about 0·002 mm. in diameter, which shines brilliantly with reflected light, and which is evidently a contained air-bubble; now air-bubbles when unconfined always work their way out of balsam, and their presence in these bodies is therefore probably due to confinement within some limiting membrane; and the question suggests itself whether they may not occupy cavities left vacant by the exhaustion of the pigment, from pigment granules now represented by the pale circular bodies, in which the air-bubbles occur. The apparent absence of protoplasm from the pigment-cells may be more apparent than real, but till this is shown to be the case it leaves the question of the relations between the two kinds of cells in a very unsatisfactory position.

In addition to the preceding cells a third element (Pl. XIX. figs. 14, 15) enters into the composition of the ectosome, and this is of an altogether problematical character. It presents itself as minute oval or elongate finger-biscuit-shaped bodies, exceedingly numerous, evenly and darkly stained, evenly and very finely granular (fig. 15), and sometimes marked with faint, longitudinal, undulating striations (wrinkles ?) (fig. 14). At one end towards the side a small, more darkly stained oval body sometimes occurs, and may represent a nucleus. Each of these bodies, on an average 0·01 by 0·006 mm. in size, lies within an oval vesicle in the surrounding collenchyma, about 0·016 by 0·012 mm. in size.

Choanosome.—The mesoderm is a well-marked sarcenchyma, in which, however, oval cells containing a protoplasmic reticulum, like those of the ectosome, and pigment-cells as well, are abundantly present; in addition are met with, lying each in its own cavity, large (0·024 mm. in diameter) rounded or polygonal, deeply stained, granular, naked, protoplasmic cells, with a large oval nucleus 0·012 mm. in diameter, which is surrounded by a darkly stained margin, and contains a spherical nucleolus 0·004 mm. in diameter. These cells are numerous in places, as many as seven sometimes being seen together in one portion of the field of the microscope. The figure (Pl. XIX. fig. 13) represents one of these cells; the wash of colour in the cavity it occupies should have been omitted, and

the boundary of the nucleus should have been defined by a dark line. At first I was inclined to regard these cells as developing ova, but subsequent examination leads me to think that they may be the parents of the pigment-cells, for frequently one may observe one of rounded form becoming resolved at the outer margin into a number of spherical protoplasmic bodies of about the same size as the pigment-spherules; and in one instance I observed the nucleus of one of these cells unchanged in character, but surrounded by a crowd of spherical protoplasmic bodies, many of them presenting a central cavity in which a small spherical granule could be discerned.

Canal System.—The incurrent canals of the ectosome do not form chones, they wander irregularly across it, and are continued without modification into the incurrent canals of the choanosome. The flagellated chambers are either aphodal or slightly diplodal, they vary from 0·024 by 0·028 mm. to 0·03 by 0·03 mm. in diameter.

The Skeleton.—The chief megascleres are oxeas, which are not collected into bundles or fibres, nor are fusiform cells associated with them: indeed fusiform cells are remarkably scarce in all parts of the sponge, chiefly, if not solely, occurring in the outermost layer of the ectosome. The ectosomal oxeas, which do not differ from those of the choanosome, lie in various directions, some at right angles to the surface, some obliquely, and many tangentially; a superficial layer of tangentially-lying oxeas occurs immediately below the outer epithelium. No sort of arrangement can be distinguished in the distribution of the choanosomal oxeas, which densely crowd the interior of the sponge. The dichotriænes are of remarkably small size compared to the oxeas, and are confined to the ectosome. In the plate (Pl. XIX. fig. 7) a second smaller oxea is represented as a characteristic spicule of the sponge; this is an error, due to the presence of the incrusting Monaxonid, the spicules of which must have got mixed with those of the *Stryphnus* on boiling out. The amphiasters occur throughout the sponge, but are especially characteristic of the ectosome; the oxyasters are almost peculiar to the choanosome, but a few occur in the ectosome.

Subfamily 4. Rhabdasterina.

Heterasterose Stellettidæ in which the additional microsclere is a microrabd.

Genus 9. *Psammastra*, n. gen.[1]

The ectosome is a thick fibrous cortex containing embedded foreign bodies; its surface is conulose. The megascleres include peculiar cladoxeas. The microrabd is a microstrongyle.

[1] ψάμμος, ἡ, sand.

Psammastra murrayi, Sollas (Pl. XXXVIII. figs. 1–12).

Psammastra murrayi, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 195, 1886.

Sponge (Pl. XXXVIII. fig. 1) more or less spherical, resembling *Cranella*; surface raised into conules of unequal size and unequal distances apart; reticulately ridged, ridges on the sides of the conules, radiating from their summits. Oscules, more than one in number, small, opening at the base or sides of the conules. Pores small, in sieves in oval areas formed by the reticulation of the surface. Cortex thick, fibrous, crowded with embedded grains of sand and other foreign bodies, produced at the base into strong fibrous processes for attachment.

Spicules.—I. Megascleres. 1. *Oxea*, straight, fusiform, sharply or roundly pointed: 4·65 by 0·065 mm.

2. *Plagiotriæne* (Pl. XXXVIII. fig. 3), rhabdome conical, sharply or roundly pointed at the proximal end; cladi simple, short and stout, conical, gently curving forwards and outwards. Rhabdome 3·9 by 0·071 mm., cladi 0·097 to 0·116 mm. long, chord from 0·16 to 0·175 mm.

3. *Cladoxeas* (Pl. XXXVIII. figs. 4–8), or modified triænes. Rhabdome a strongyloxea, at the oxeate end sharply or roundly pointed, at the cladal end strongylate; cladi variable in number, from two to four, usually three; simple, conical, or one or more bifurcate in a horizontal or vertical plane; proceeding from the rhabdome a little distance below its strongylate termination, sometimes projecting at right angles to the axis of the rhabdome, sometimes recurved, sometimes one or more projecting forwards, and the others backwards; the axial fibre usually proceeding outwards and backwards for the first part of its course. Rhabdome 3·22 by 0·0775 mm., extending distally beyond the cladal origin a variable distance, frequently 0·045 mm.; cladi 0·05 mm. long measured from the exterior of the rhabdome, 0·065 mm. from the cladal origin. The dimensions are very variable, and those given are to be regarded as averages.

II. Microscleres. 4. *Microstrongyle* (Pl. XXXVIII. fig. 10), a short cylindrical strongyle, sometimes constricted in the middle, minutely and irregularly spined all over the surface; 0·012 to 0·016 by 0·00395 mm.

5. *Oxyaster* (Pl. XXXVIII. fig. 11), centrum small or inappreciable, actines slender, conical, bearing a few minute erect spines near the extremities, total diameter 0·02 to 0·024 mm.

6. *Spheraster* (Pl. XXXVIII. fig. 12), centrum about one-third of the diameter of the spicule, actines conical, numerous, sharply pointed; total diameter 0·012 to 0·016 mm. The oxyasters and spherasters occur mingled together, and can only be regarded as accidental modifications of the same form.

Colour.—Ochreous-brown on the sides and upper surface, the ends of the conules

deeper in tint, almost orange coloured; the lower surface where not exposed to the light of a pale grey tint.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells. Dredged.

Remarks.—Of this conulose Stellettid a single specimen was dredged; it measures from 45 to 50 mm. in diameter. The conules vary from 1 to 5 mm. in height. There are three evident oscules situated near the base of the sponge, and indications of others; of the three, the two smaller are about 2 mm. in diameter, the third larger is about 5 mm. in diameter. The two smaller oscules open each at the base of a conule which overhangs them, the third larger is situated on the summit of an irregular tent-like elevation, with a conule at each side of its margin. It leads into a system of wide intercortical canals (constricted into vesicles by numerous vela), which receive the excurrent canals from the choanosome through sphinctrate apertures.

The pores of the pore-sieves are very small, usually from 0·008 to 0·015 mm. in diameter, they lead into widely extending intercortical cavities, which are converted by numerous velar partitions into a network of vesicles, and which communicate with the incurrent canals of the choanosome by descending radial canals.

The cortex (Pl. XXXVIII. fig. 2), about 2 or 3 mm. in thickness, consists almost entirely of fibrous tissue, the fusiform cells of which run in various directions concentric with the surface. Embedded in the tissue are abundant angular grains of quartz sand, and occasional Foraminifera and other foreign bodies, usually ranging between 0·08 and 0·5 mm. in diameter, on the average about 0·2 mm. The presence of these sand grains makes it impossible to obtain other than very thick slices of the cortex. The mesoderm of the choanosome is a sarcenchyma, except where it forms the walls of the larger canals; these are collenchymatous.

Skeleton.—The megascleres are arranged in radial bundles, and the triænes and cladoxeas are first met with in the choanosome just below the cortex. The remarkable cladoxeas are more numerous than the triænes, occurring as the staple cladose spicule of the skeleton. This is the case in no other known Tetractinellid, for though similar forms may occasionally be found where the spicules are unusually massive and densely packed, as in *Ecionema pyriformis*, they are never other than exceptional and evidently abnormal varieties. These abnormal varieties are, however, of the highest interest, since the conditions which have exceptionally operated to produce them in one sponge may become general in their action in another, and thus lead to the multiplication of the abnormal into the characteristic or prevailing form. Of this process the instances afforded by the sponges are almost numberless, one of the commonest being the abnormal occurrence of oxystrongyles, strongyloxeas, and strongyles in skeletons composed otherwise solely of oxeas. It is in the study of these changes that we may find a clue to the

conditions under which particular forms have been evolved. In the case of *Psammastra* we have seen that somewhat similar cladoxeas are exceptionally met with in *Ecionema pyriformis* where they are associated with an unusually dense skeleton, consisting of massive spicules closely packed together into fibres. In *Psammastra murrayi* these spicules are associated with an exceptional character in the cortex, the abundant presence of angular quartz grains, and in both cases the deviation from the average triæne type would thus appear to be due to secondary pressures and tensions, due in the one case to the close packing of the spicules, and in the other to the presence of opposing sand grains.

It is possible that the unusual forms produced under these circumstances may afterwards become preserved by inheritance, and we may thus explain the presence of cladoxeas in the choanosome, where the pressures due to the presence of sand grains do not exist.

In concluding these remarks on the cladoxeas one may mention that they are present in greater variety than is described under the heading of spicules, and that the axial fibre in the vicinity of the cladal origin frequently gives rise to more numerous branches than those which enter the cladi. In some cases, just below the cladal origin, three fibres passing off backwards and outwards from the main axis into the substance of the rhabdome have been observed. These accessory branches have no effect whatever on the external form of the rhabdome.

The microstrongyles are scattered through both choanosome and cortex, though they are more abundant in the latter, and immediately beneath its investing epithelium they occur in a single layer, arranged as closely as possible together without actually touching. The asters occur in the inner part of the cortex, but are chiefly distributed through the choanosome.

Appendix to the Euastrosa.

Family Epipolasidæ.[1]

Euastrosa (?) without triænes, possessing oxeas and one or more forms of aster. The oxeas arranged partly in radiating fibres, partly scattered loosely in the choanosome; in the ectosome they lie tangentially. The chamber system (so far as investigated) diplodal.

Genus *Amphius*,[2] n. gen.

Possessing but one form of microsclere, an amphiaster. Chamber system diplodal.

[1] ἐπιπολάζω, to lie on the surface, in allusion to the tangential position of the ectosomal oxeas.

[2] Ἄμφιος, a Homeric hero, Il., ii. 830.

Amphius huxleyi, n. sp. (Pl. XLII. figs. 5–11).

Sponge (Pl. XLII. fig. 5) massive, lobate, attached; lobes axially excavated by a large deep cylindrical cloaca; oscules situated on the summits of the lobes, each the scarcely constricted opening of the cloaca (Pl. XLII. fig. 8); oscular margin membranous. Pores small, in sieves, which overlie the incurrent canals (Pl. XLII. figs. 9–11). Surface smooth, formed of a thin, now wrinkled, skin, supported by tangentially lying, scattered oxeas. Texture soft.

Spicules.—I. Megasclere. 1. *Oxea* (Pl. XLII. fig. 6), slender, cylindrical, points blunt or tornote; 0·588 by 0·007 mm.

II. Microsclere. 2. *Amphiaster* (Pl. XLII. fig. 7), axis minute, cylindrical, actines slender, cylindrical, terminally tylote; arranged in a whorl at each end of the axis, and with a single one continuing the direction of the axis; total length 0·016 mm., of the axis 0·004 mm.

Colour.—Nut-brown externally, yellowish-grey within.

Habitat.—Off Api, New Hebrides; depth, 60 to 70 fathoms.

Remarks.—There is a single entire specimen of this sponge; it measures 68 mm. in height, 112 mm. in length, and 57 mm. in breadth. The largest oscule measures 9 mm. and 10 mm. along two rectangular axes, the smallest is about 4 mm. in diameter; the largest cloaca is 31 mm. in depth, the smallest 5 mm. The excurrent canals radiate from the cloacas, running more or less parallel to the curved upper surface of the lobes in which they lie. The ectosome is thin, not more than 0·1 mm. thick; it consists of what might be called fibrous sarcenchyma, *i.e.*, a granular deeply staining matrix, containing fusiform cells about 0·04 mm. in length. Notwithstanding the markedly brown colour of the skin, I could detect no special pigment-cells. The ectosome passes insensibly into the choanosome, the mesoderm of which is sarcenchymatous. The flagellated chambers are diplodal with short prosodi, they measure 0·0237 mm. in diameter. The water-canals are provided with velar diaphragms.

The oxeas are partly scattered singly through the sponge, partly loosely aggregated into narrow fibres, but never bound together by spongin. The fibrous spicular tracts appear to run more or less parallel to the chief water-canals. The tangential spicules of the ectosome partly consist of the most superficially situated of the singly scattered oxeas, and are partly provided by the spicular fibres which curve from the radial to the tangential position as they approach the surface.

Supplemental Account of all other known Species of Stellettidæ not in the Challenger Collection.

Subfamily 1. Homasterina, Sollas.

Myriastra crassicula (Carter).

Stelletta crassicula, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vii. p. 371, 1881.

Sponge small, spherical, attached; oscules single, dispersed; pores in sieves; surface hispidated by projecting anatriænes.

Spicules.—I. Megascleres. 1. *Somal oxea*, fusiform, 2·6 mm. long. 2. *Ectosomal oxea*, 0·317 mm. long. 3. *Orthotriæne*, rhabdome 2·6 by 0·07 mm. 4. *Anatriæne*, rhabdome 2·6 mm. in length and over; cladome, chord 0·17 mm. long.

II. Microsclere. 5. *Chiaster*, actines slender, not tylote, 0·0085 mm. in diameter.

Colour.—Brownish-grey.

Habitat.—Basse Rocks, Gulf of Manaar.

Remarks.—Carter regards the ectosomal oxea as a microsclere, and speaks of it as characterising the sponge by its large size. No information is given as to the position of this spicule in the ectosome, but judging from some remarks which Mr. Carter was kind enough to send me supplementing his description, I conclude that it does not lie tangentially like the microxea of *Papyrula*, but radially like the ectosomal oxea of *Ecionema* or *Anthastra*. As the sponge does not appear to possess a cortex, and as the chiaster is the only form of microsclere present, I assign the species to the genus *Myriastra*.

Myriastra simplicissima (O. Schmidt).

Ancorina simplicissima, O. Schmidt, Spong. Küste v. Algier, p. 18, pl. iii. fig. 9, pl. iv. fig. 9, 1868.

Sponge.—Massive, irregular, knoll-like, or pear-shaped, surface round; oscules numerous, canal system well developed; cortex thin.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, frequently somewhat suddenly bent in the middle, 2·7 by 0·08 mm. 2. *Plagiotriæne*, rhabdome conical, straight, 1·6 by 0·065 mm., cladi short, conical, not very sharply pointed, 0·2 mm. in length.

II. Microsclere. 3. *Chiaster*, actines numerous, bacillary, truncate, never tylote. Two forms of this spicule are to be distinguished; one, somewhat smaller than the other, occurs immediately beneath the investing epithelium; it measures 0·0118 mm. in diameter, and presents a minute but evident centrum; the other form is generally distributed throughout the sponge, it measures 0·017 mm. in diameter and presents no

trace of a centrum; the two forms, though distinguishable, are so similar, that I have not thought it worth while to remove the sponge from the Homasterina, as it is evidently most closely related to *Myriastra*.

Colour.—Brownish. Size, 70 mm. in height.

Habitat.—Coast of Algiers.

Remarks.—The specimen of this sponge which I have examined, I owe to the kindness of Professor Perrier.

Pilochrota cingalensis, n. sp.

Sponge (?).

Cortex thin, about 0·35 mm. in thickness.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, frequently curved, more or less bluntly pointed, 1·43 by 0·035 mm. 2. *Orthotriæne*, rhabdome conical, bluntly pointed or strongylate, 1·43 by 0·058 mm.; cladi 0·12 mm. in length. 3. *Anatriæne*, rhabdome cylindrical, slender, bluntly pointed or strongylate, 1·27 by 0·017 mm.; cladi 0·058 mm., chord 0·08 mm., sagitta 0·055 mm. in length.

II. Microsclere. 4. *Chiaster*, actines slender, variable in number and length, terminally tylote, 0·016 mm. in total diameter.

Colour.—Light brown.

Habitat.—Galle, Ceylon.

Pilochrota fibrosa (O. Schmidt).

Ancorina fibrosa, O. Schmidt, Spong. Atlant. Gebiet., p. 67, 1870.

Sponge.—An irregular thick incrustation, with a clearly differentiated cortex.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 1·43 mm. by 0·027 mm. 2. *Plagiotriæne*.

II. Microsclere. 3. *Chiaster*, centrum absent, actines slender, bacillary, tylote, about six to twelve in number; total diameter 0·012 mm.

Habitat.—Florida; depth, 119 fathoms.

Remarks.—I am indebted to Dr. Ernst Ziegler of Strasburg for the opportunity of examining one of Schmidt's mounted preparations of this sponge; like the description it is inadequate; the chiasters, however, are clearly shown, and one cannot but wonder how Schmidt came to overlook them, they resemble those represented on our Pl. XIV. figs. 19 and 20; the megascleres are said by Schmidt to resemble those of *Ancorina simplicissima*, O. Schmidt.

Pilochrota (*?*) *lactea* (Carter).

Stelletta lactea, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. vii. p. 9, pl. iv. figs. 17–21.
,, ,, Norman, Mon. Brit. Spong., Bowerbank, vol. iv. p. 210, 1882.

Sponge small, filling small excavations made on rocks by *Saxicava* and other boring animals.

Spicules.—I. Megascleres. 1. *Oxea*, 1·25 mm. long. 2. *Orthotriæne* and *dichotriæne*, 0·825 mm. in length.

II. Microscleres. 3. *Spheraster*, minute, centrum of variable size, sometimes almost absent, sometimes of much greater diameter than the length of the actines; actines numerous, slender, oxeate, truncate, or rarely tylote; 0·0125 mm. in diameter. 4. *Orthodragma*, confined to the choanosome, 0·025 mm. in length.

Colour.—White externally.

Habitat.—South Devonshire.

Remarks.—As I am ignorant of the structure of the cortex of this species it is with considerable hesitation that I place it in the genus *Pilochrota*; the orthodragmas, as stated by Carter, are confined to the choanosome, and there is no necessity therefore to assign it to *Dragmastra*, with which it is evidently not nearly related.

Astrella anceps (O. Schmidt).

Stelletta anceps, O. Schmidt, Spong. Adriat. Meeres, Suppl., iii. p. 31, 1868.

Sponge forming irregular crusts; cortex from 0·8 to 1·6 mm. in thickness, apparently not differentiated into two layers; surface hispid.

Spicules.—I. Megascleres. 1. *Oxea*, 1·78 by 0·045 mm. 2. *Orthotriæne*, 1·25 mm. in length; esactine frequently shortened and strongylate; cladi 0·142 mm. long. This spicule is frequently reduced to a diæne.

II. Microsclere. 3. *Pycnaster*, from 0·013 to 0·02 mm. in diameter (0·0098 mm., O. Schmidt); this is a remarkably variable form, passing into oxyasters, chiasters with bacillary truncate actines and spherasters, without, however, changing its size.

Colour.—Cortex violet.

Habitat.—Cette, Algiers.

Remarks.—This sponge is very closely allied to *Astrella pumex*, from which it is distinguished by the difference in the form of the cladome of the triænes. I have provisionally assigned it to the genus *Astrella*, but am much inclined to think that its better place would be with *Pilochrota*.

Astrella dorsigera (O. Schmidt).

Stelletta dorsigera, O. Schmidt, Spong. Adriat. Meeres, Suppl., p. 31, 1868.

Sponge.—Spherical, surface raised into very irregular conules; pores large, in sieves, cortex thick, differentiated into a cavernous outer half and a dense fibrous inner half, containing a few grains of sand and other foreign bodies scattered through it. Outer ends of the chones enlarged into wide cavities into which the pores open; inner ends conical, constricted into narrow canals, which open into the subcortical crypts.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, sharply pointed, 3·0 by 0·06 mm.

2. *Orthotriæne*, rhabdome conical, sharply pointed or strongylate; cladi conical, sharply pointed. Rhabdome 1·6 by 0·06 mm., cladi 0·127 mm., chord 0·223 mm. long.

II. Microsclere. 3. *Chiaster*, centrum very small, actines cylindrical, strongylate or truncate, varying in number from four to many; average diameter 0·016 mm., forms with four actines only, as much as 0·024 mm. in diameter. These asters form a layer beneath the epithelium, and are distributed generally throughout the sponge.

Colour.—Blackish-brown externally, greyish-white within.

Habitat.—Lesina, in the Adriatic Sea.

Remarks.—At first I assigned this sponge to the genus *Psammastra*, but since it does not contain the characteristic microstrongyle, I am now inclined to regard it as an aberrant form of *Astrella*, from which it differs chiefly in possessing conules. These, however, are different in character from those of *Psammastra murrayi*, being much more irregular. The orthotriænes are subject to modifications somewhat similar to those of the last-named species; thus they are frequently reduced to oxystrongyles and oxytylotes, the latter usually retaining their triæne character by a branching of the axial fibre; the former usually not, but yet frequently indicating their origin by the presence of one or more cladi irregularly given off some distance below the strongylate end; in one instance an oxystrongyle was observed bearing a single normal dichocladus.

The pores are large, varying from 0·0326 to 0·1 mm. in diameter.

Astrella pumex (O. Schmidt).

Stelletta pumex, O. Schmidt, Spong. Adriat. Meeres, Suppl., p. 32, pl. iii. fig. 9, 1864.

Sponge.—Irregularly incrusting, surface hispid.

Spicules.—I. Megascleres. 1. *Oxea*, 2·13 by 0·044 mm. to 2·7 by 0·06 mm. 2. *Plagiotriæne*, rhabdome 1·43 by 0·055 mm., cladus 0·286 mm. long.

II. Microsclere. 3. *Pycnaster*, small and variable in form, passing into oxyasters, spherasters, and chiasters without change of size, 0·019 mm. in diameter.

Colour.—Blue-black externally, yellowish-white within.

Habitat.—Venetian Canal.

Remarks.—Schmidt's representations of the spicules of this sponge are so misleading, that no one without access to the type could identify it. The spinose styles which he describes and figures are not present, nor, though one might imagine so from the figure, are orthodragmas. The sponge is so similar to *Astrella anceps*, O. S., that it is only after considerable hesitation that I venture to keep the two species as distinct. The form of the cladome of the plagiotriæne in *Astrella pumex*, due to the very forwardly directed curve of the cladi, appears however to be somewhat characteristic. The spicules appear to be very variable in dimensions; those given are maxima. The reference of the species to *Astrella* is only doubtfully made.

Subfamily 2. Euasterina.

Anthastra æruginosa (Carter).

Stelletta æruginosa, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xvii. p. 123, 1886.

Sponge spherical, sessile; surface smooth; oscules distinct, irregularly scattered; pores in sieves; ectosome thin, 0·32 mm. in thickness.

Spicules.—I. Megascleres. 1. *Oxea*, 1·117 by 0·01 mm. 2. *Orthotriæne*, rhabdome 1·456 by 0·0125 mm., cladi 0·238 mm. in length, chord 0·42 mm. 3. *Anatriæne*, rhabdome 1·03 mm. long and probably longer, by 0·013 mm. in diameter; cladome small, well rounded in front, cladi 0·032 mm., chord 0·045 mm., sagitta 0·029 mm. in length.

II. Microscleres. 4. *Anthaster*, with few actines, each 0·012 mm. long. 5. *Chiaster*, numerous fine hair-like actines, not tylote, a minute spherical centrum sometimes present; 0·016 mm. in diameter.

Colour.—Verdigris-green or blue throughout. Size, 25 mm. in diameter.

Habitat.—Port Phillip Heads, South Australia; depth, 6 fathoms.

Remarks.—Mr. Carter generously presented me with a whole specimen of this sponge. It does not present the green colour from which the species takes its name. The oscule is small, with a well-defined margin, and leads into a small cloaca; neither the margin of the oscule nor the walls of the cloaca are hispidated by small oxeas. The small rounded cladome of the anatriæne is characteristic.

Anthastra mammilliformis (Carter).

Stelletta mammilliformis, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xvii. p. 124, 1886.

Sponge globoconical, mammilliform, sessile; surface more or less covered with attached grains of sand; oscule single, terminal, large. Ectosome thin; not a cortex.

Spicules.—I. Megascleres. 1. *Oxea*, 1·46 mm. in length. 2. *Dichotriæne*, rhabdome 1·46 mm. in length, protocladi 0·08 mm., deuterocladi 0·103 mm. in length, chord 0·35 mm. 3. *Anatriæne*, rhabdome 0·008 mm. in diameter, cladi 0·039 mm., chord 0·0645 mm., sagitta 0·021 mm. in length.

II. Microscleres. 4. *Anthaster*, actines variable in number, usually five to seven, 0·016 mm. in length. 5. *Chiaster*, actines slender, hair-like, not tylote, total diameter, 0·02 mm.

Colour.—Whitish-grey. Size, 13 mm. in diameter.

Habitat.—Port Phillip Heads, South Australia.

Remarks.—Mr. Carter had the kindness to send me part of a spirit-specimen of this sponge, and I am thus able to assign it to the genus *Anthastra* with certainty.

Stelletta boglicii, O. Schmidt.

Stelletta boglicii, O. Schmidt, Spong. Adriat. Meeres, p. 47, pl. iv. fig. 4, 1862.

Sponge spherical; surface hispid, covered with attached foreign bodies; cortex about 2·14 mm. in thickness.

Spicules.—I. Megascleres. 1. *Oxea*, from 2·78 by 0·07 to 3·08 by 0·06 mm. 2. *Plagiotriæne*, rhabdome 1·8 by 0·07 mm., cladi from 0·07 to 0·127 mm. in length. This spicule is frequently reduced to a diæne or monæne.

II. Microscleres. 3. *Ectosomal chiaster*, actines slender, bacillary, terminally truncate, 0·012 mm. in diameter. 4. *Choanosomal oxyaster*, actines numerous, conical, passing into a small centrum, a single actine from 0·013 to 0·0236 mm. long.

Colour.—Brown externally, white within.

Habitat.—Lesina, at considerable depths in the Adriatic Sea.

Remarks.—The plagiotriænes are reduced through all stages down to an oxea; one cladus may be present, and the axial fibres of two others, or the axial fibres may also be absent; the single cladus may arise as an evident branch from the rhabdome, or may form merely the bent termination of an oxea.

Stelletta coactura (Bwk.).

Ecionema coactura, Bowerbank, Mon. Brit. Spong., vol. iii. p. 269, pl. lxxxii. figs. 13–19, 1874.

Sponge massive, free; surface even, hispid, covered with numerous small pebbles and other attached foreign bodies; oscules inconspicuous; pores in sieves, large; cortex nearly 2 mm. in thickness.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, tornote, 1·91 by 0·04 mm.

2. *Orthotriæne*, rhabdome tornote or sometimes strongylate; cladi geniculate. Rhabdome 1·625 by 0·05 mm., cladi 0·12 mm. long, chord 0·22 mm.

3. *Anatriæne*, rhabdome slender; cladi prolonged backwards a considerable distance.

II. Microscleres. 4. *Ectosomal chiaster*, with thick bacillary actines, rounded at the ends, very similar to a pycnaster, 0·0156 mm. in diameter.

5. *Choanosomal oxyaster*, with few long slender actines and no centrum, frequently reduced to a triradiate form; a single actine 0·0276 mm. in length.

Colour.—In spirits, light green.

Habitat.—Off Guernsey (Saville Kent).

Remarks.—The anatriænes must be extremely rare or local in their distribution, none are to be seen in the preparations which I made from the type specimen in the British Museum. The characters of the cortex are not clearly shown in these preparations, but it appears to consist chiefly of collenchyma.

Stelletta collingsii (Bowerbank).

Tethea collingsii, Bowerbank, Brit. Spong., vol. ii. p. 87, 1866; vol. iii. p. 37, pl. xv. figs. 1–9, 1874; and vol. iv. p. 44, 1882.
Collingsia sarniensis, Gray, Proc. Zool. Soc. Lond., p. 541, 1867.
Tethea schmidtii, Bowerbank, Brit. Spong., vol. ii. p. 89, 1866; vol. iii. p. 38, pl. xv. figs. 10–16, 1874; and vol. iv. p. 44, 1882.
Collingsia schmidtii, Gray, Proc. Zool. Soc. Lond., p. 541, 1867.

Sponge.—Massive, sessile; oscules and pores (?); cortex thick (?).

Spicules.—I. Megascleres. 1. *Oxea*, 1·96 by 0·032 (*s*) to 2·44 by 0·0434 mm. (*c*).

2. *Orthotriæne;* rhabdome 1·27 by 0·0478 mm. (*s*) to 1·6 by 0·055 mm. (*c*); cladome, chord 0·23 (*s*) to 0·175 mm. (*c*).

II. Microscleres. 3. *Ectosomal chiaster*, actines variable in number, usually four, tylote terminally; 0·0158 mm. in total diameter.

4. *Choanosomal oxyasters*, two varieties, both with conical sharply-pointed actines. In the one the actines are large and few, 0·02 mm. long; in the other small and numerous, 0·01 mm. long.

Colour.—In the fresh state somewhat green externally, light grey within; when dried, dull ochre-yellow.

Habitat.—The English Channel, Guernsey, Sark, Herne, Torbay; and Westport Bay, county Mayo.

Observations.—The letters "(*c*)" and "(*s*)," given after the above measurements, indicate the specimens from which they were taken; "(*c*)" stands for *Stelletta* (*Tethea*) *collingsi* from Sark, "(*s*)" for *Stelletta* (*Tethea*) *schmidtii*. The dimensions of the spicules in specimens of *Stelletta* (*Tethea*) *collingsii* from Mayo differ from the foregoing.

Thus the oxea in these measures 1·6 by 0·0237 mm., the rhabdome of the orthotriæne 1·12 by 0·0355 mm., the cladi are 0·127 mm. in length. No doubt there is considerable variation both in the form and size of the spicules of specimens from different localities.

Bowerbank rests the distinction of the two species, which we have here united under one name, on the presence of an ectosomal oxea in the one, and a corresponding tylostyle in the other. These different spicules are undoubtedly present, and would, if proper to the sponge, more than suffice for specific distinction; but, as might almost have been expected, they form no part of the *Stelletta*, occurring solely in an incrusting Monaxonid, which Bowerbank mistook for a part of the Stellettid cortex.

The asters are very variable, presenting a vast number of different forms, which pass into each other. The chiasters are precisely similar to those of *Myriastra* from the Australian seas.

Stelletta grubii, O. Schmidt.

Stelletta grubii, Oscar Schmidt, Spong. Adriat. Meeres, p. 46, pl. iv. fig. 2, 1862.

Sponge.—Subglobose, surface hispid; cortex from 1·78 to 2·25 mm. in thickness; outer layer of the cortex 0·8 mm. thick, inner layer 1·6 mm. thick.

Spicules.—I. Megascleres. 1. *Oxea;* one variety long and slender, 4·46 by 0·015 mm.; the other shorter and thicker, 2·32 by 0·045 mm.

2. *Orthotriæne;* rhabdome 2·856 by 0·0516 mm., cladi 0·16 mm. long, chord of the cladome 0·232 to 0·286 mm. long.

II. Microscleres. 3. *Ectosomal chiaster*, with rod-like terminally tylote actines, each actine 0·008 mm. long.

4. *Oxyaster;* no differentiated centrum, actines few, long, conical, sometimes reduced to two, when a centrotylote microxea results; actines of a microtriod or microxea, 0·032 mm.; of varieties in which the actines are very numerous and short, 0·008 mm. in length.

Colour.—White or grey.

Habitat.—Quarnero and Zlarin in the Adriatic (O. S.); Budleigh Salterton, Devonshire (Carter); and Holyhead (Carter).

Remarks.—In my notes of specimens examined at the British Museum I find the dimensions of the rhabdome of the orthotriæne given as 2·06 by 0·039 mm., and of the oxea as 2·38 by 0·032 mm. I think these must have been obtained from preparations kindly lent me by Dr. R. von Lendenfeld, as I also find a note to the effect that the flagellated chambers measure 0·0237 by 0·0158 mm.; an observation which can only have been made from thin slices. These the British Museum does not possess.

Mr. Carter, amongst other specimens of Stellettids, sent me one which he considered

as *Stelletta grubii*, from Holyhead; the spicules are very similar to those of Schmidt's type, and I have no doubt as to the correctness of the identification. I was not able to make out the characters of the cortex.

Genus 10. *Dragmastra*, Sollas.

Cortex similar to that of *Stelletta*, but with the middle or collenchymatous layer crowded with orthodragmas.

Dragmastra normani, Sollas.

Stelletta Normani, Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 130, pls. vi., vii., 1880.

Sponge somewhat spherical, becoming depressed, cake-like with age; sessile, attached; surface hispidated by oxeas and dichotriænes; oscules not observed; pores in sieves generally distributed; cortex 1·7 mm. thick.

Spicules.—I. Megascleres. 1. *Oxea*, 6·0 by 0·064 mm. 2. *Dichotriæne*, 3·2 by 0·094 mm., protocladi 0·39 mm. long, deuterocladi 0·57 mm. long. 3. *Protriæne*, 5·5 by 0·032 mm. 4. *Anatriæne*, 5·5 by 0·032 mm., cladi 0·127 mm. long, chord 0·127 mm.

II. Microscleres. 5. *Orthodragma*, 0·05 by 0·02 mm. 6. *Oxyaster*, 0·019 to 0·033 mm. in diameter. 7. *Chiaster*, a small centrum and numerous bacillary actines, sometimes faintly tylote, 0·012 mm. in diameter.

Colour.—Grey externally, yellowish-white within.

Habitat.—Kors Fjord, Norway; depth, 180 fathoms (Norman).

Remarks.—The orthodragmas not only form a special layer in the cortex, but are thickly scattered through the choanosome, like the sterrasters of the Geodiidæ. The large problematical oval cells (*loc. cit.*, p. 139) mentioned as surrounding the subcortical crypts are, as I now believe, the scleroblasts of the orthodragmas.

Genus 11. *Aurora*, n. gen.

The cortex not differentiated into two layers; densely crowded with large spherasters.

Aurora globostellata (Carter).

Stelletta globostellata, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xi. p. 353, pl. xiv. fig. 5, 1883.

Sponge.—Surface smooth, raised into low, undulating ridges, united to form a reticulation; pores singly situated in its meshes; oscules congregated. Cortex, 0·26 mm. thick.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 0·875 by 0·028 mm. 2. *Orthotriæne*, rhabdome 0·625 by 0·0173 mm., cladi 0·18 mm. long.

II. Microscleres. 3. *Spheraster*, 0·05 mm. in diameter, the conical actines traversed by an axial fibre. 4. *Chiaster*, with slender, hair-like, truncate actines, confined to the choanosome, 0·015 mm. in diameter. 5. *Orthodragma*, also confined to the choanosome, 0·158 mm. in length.

Colour.—White externally, ochreous-yellow within. Size, 75 mm. in width by 37·5 mm. in thickness.

Habitat.—Galle, Ceylon.

Aurora reticulata (Carter).

Stelletta reticulata, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xi. p. 352, pl. xiv. fig. 4, 1883.

Sponge somewhat globular, lobate; oscules on the prominent part of the lobes; surface uniformly reticulate; cortex, 0·26 mm. thick.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 0·902 by 0·0243 mm. 2. *Orthotriæne*, rhabdome 0·56 by 0·027 mm., cladi 0·069 mm. long.

II. Microscleres. 3. *Spheraster*, with truncated actines, minutely spined at the ends, 0·032 mm. in diameter. 4. *Chiaster*, 0·008 mm. in diameter.

Habitat.—Unknown.

Subfamily 3. Sanidasterina.

Genus 12. *Ancorina*, O. Schmidt.

Sanidasterose Stellettidæ with a well-developed cortex which is not produced into tubular outgrowths.

Ancorina cerebrum, O. Schmidt.

Ancorina cerebrum, O. Schmidt, Spong. Adriat. Meeres, p. 51, pl. iii. fig. 28, 1862.
Ancorina verruca, O. Schmidt, *op. cit.*, p. 52, pl. iii. fig. 29, 1862.

Sponge.—Large, globose, lobate, with a folded surface like that of a human brain. Cortex 1·79 to 3·0 mm. thick, outer layer collenchymatous, containing oval cells with thin walls and spherical pigment granules, about 0·048 mm. in diameter, excavated by intercortical cavities, from 0·36 to 0·72 mm. in thickness; inner layer fibrous, from 1·1 to 2·6 mm. in thickness.

Spicules.—I. Megascleres. 1. *Oxea* 3·0 by 0·0516 mm. (*c*), to 3·0 by 0·058 mm. (*v*). 2. *Dichotriæne*, rhabdome 3·4 by 0·6 mm. (*c*), to 3·25 by 0·039 (*v*), protocladus 0·064 mm., deuterocladus 0·0774 mm. long. 3. *Anatriæne*, rhabdome 3·4 by 0·026 mm., cladi 0·1 mm., chord 0·15 mm. long.

II. Microscleres. 4. *Ectosomal sanidaster*, 0·008 mm. in length. 5. *Somal chiaster*, actines slender, terminally tylote, each 0·008 mm. in length.

Colour.—Sky-blue; *Ancorina verruca* in the dry state brown.

Habitat.—Zara, Quarnero, in the Adriatic (*c*), and Porto Kimen, Island of Cherso (*v*).

Remarks.—The species *Ancorina verruca*, O. S., was founded on a single specimen, and in its minute structure I can distinguish no character by which it can be separated from *Ancorina cerebrum*.

Ancorina wageneri (O. Schmidt).

Stelletta wageneri, O. Schmidt, Spong. Adriat. Meeres, p. 46, pl. iv. fig. 3, 1862.
Stelletta immunda, O. Schmidt, *Ib.*

Sponge.—Subglobose, about 2 inches in diameter, with an irregular central closed cavity. Cortex about 2 mm. in thickness, the outer layer (widely excavated by intercortical cavities) is from 0·625 to 0·7 mm. in thickness, and the fibrous inner layer 1·27 mm.

Spicules.—I. Megascleres. 1. *Oxea*, 2·856 by 0·064 mm. 2. *Dichotriæne*, rhabdome 3·4 by 0·058 mm., protocladus 0·058, deuterocladus 0·1 mm. in length. 3. *Anatriæne*, rhabdome 3·4 by 0·035 mm., cladus 0·165 mm. long, chord 0·175 mm.

II. Microscleres. 4. *Ectosomal sanidaster*, 0·008 mm. long. 5. *Somal chiaster*, with slender tylote actines, a single actine 0·008 mm. long. 6. *Choanosomal oxyaster*, centrum not differentiated, actines few, large, conical, usually sharply pointed, a single actine may attain a length of 0·045 mm., average length 0·032 mm.

Colour.—Apparently bluish in the fresh state; due to the presence of large oval cells, with thin walls, of a deep brown colour in the dried state, 0·06 mm. in diameter.

Habitat.—Quarnero, Adriatic.

This species is distinguished from *Ancorina cerebrum*, O. Schmidt, by the presence of choanosomal oxyasters.

Genus 13. *Tethyopsis*, Stewart, 1870.

Non Zittel, Abhandl. d. II. Cl. k. baier. Akad. d. Wiss., xiii., ii., p. 9, 1879.

Sanidasterose Stellettidæ provided with a special excurrent tube; the existence of a special incurrent tube is doubtful; the four chief excurrent canals are tetragonally arranged. The megascleres of the excurrent tube are modified orthotriænes. The microscleres are spherasters, chiasters, and orthodragmas; sanidasters are absent.

Tethyopsis columnifera, Stewart.

Tethyopsis columnifer, C. Stewart, Monthly Micr. Journ., vol. x., N.S., p. 281, pl. xviii., 1870.

Sponge more or less spherical, basal half torn away, produced into a special excurrent tube, the surface of which is raised into somewhat conical, compressed ridges, spirally arranged. Surface of the sponge incrusted with attached foreign bodies.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 7·0 by 0·06 mm., rare.

2. *Somal orthotriæne*, rhabdome 6·84 by 0·11 mm., cladi 0·4 mm. in length.

3. *Cloacal orthotriæne*, with one cladus much elongated.

II. Microscleres. 4. *Ectosomal spheraster*, minute, with a comparatively large centrum, actines reduced to rounded tubercles, 0·008 mm. in diameter.

5. *Choanosomal chiaster*, centrum small, actines numerous and slender, hair-like; reminding one of a young form of sterraster, 0·02 mm. in diameter.

6. *Orthodragma*, 0·0276 mm. long; scattered through the choanosome.

Colour.—White.

Habitat.—Philippine Islands.

Remarks.—The single specimen existing of this sponge is mutilated at the base, so that no traces of an incurrent tube, if it ever possessed one, remain. The sponge-body measures about 35 mm. in diameter, the cloacal tube 42 mm. in length by 7·5 mm. in diameter.

The species differs in many respects from *Disyringa dissimilis*; the two characters on which I rely for their generic distinction are primarily the absence of sanidasters in *Tethyopsis columnifera*, these being replaced by spheraster, and secondarily the absence of tangentially arranged oxeas in the cortex.

Characters of minor importance are the general absence of diænes and monænes in the sponge-body, and of modified dichotriænes in the cloacal tube; the absence of longitudinal tracts formed by the rhabdomes of the triænes in the cloacal tube, excepting those which form the central axis, and as a consequence, the absence of a spicular framework for the support of the dermal membrane of the tube, this resting on the ends of the cladi of the triænes and not on their sides. Orthodragmas, although present in *Disyringa dissimilis*, do not occur in the choanosome, while in *Tethyopsis columnifera* they do.

Tethyopsis radiata (Marshall).

Agilardiella radiata, Marshall, Abhandl. d. k. Akad. d. Wiss. Berlin for 1883, 1884.

Sponge.—Unknown, excurrent or cloacal tube cylindrical, rounded at the distal end, raised into eight long low ridges, separated by shallow groves, longitudinally and somewhat spirally arranged, consisting of a small axial canal surrounded by eight larger peripheral canals. Rhabdomes of the orthotriænes longitudinally disposed in the wall of the axial canals (or in the axis of the tube ?).

Spicules.—I. Megascleres. 1. *Oxea*, 25 mm. in length, possibly as long as the cloacal tube, viz., 55 mm.

2. *Orthotriænes*, rhabdome long, lying longitudinally in the wall of the central canal; cladi, two paired and shorter lying horizontally in the wall of the central canal, the third unpaired and longer extending radially through walls of adjacent peripheral canals up to the dermal membrane.

3. *Modified diænes*, rhabdome long, disposed as in the case of the orthotriænes; cladi unequal in length, one directed like the unpaired cladus of the orthotriæne, the other bent upwards, continuing the direction of the rhabdome.

4. *Triods*, these represent the cladome of an orthotriæne, in which the rhabdome has entirely disappeared; the cladi or actines are arranged like the cladi of the orthotriæne.

II. Microsclere. 5. *Spheraster*, with numerous short conical actines, 0·007 to 0·01 mm. in diameter. These form an almost continuous layer beneath the outer epithelium.

Colour.—Chalky-white when dry.

Habitat.—North New Zealand; 45 fathoms (expedition of the "Gazelle").

Remarks.—This species is founded on specimens of the cloacal tube of a *Tethyopsis*, which evidently very closely resembles, if indeed it is not identical with, *Tethyopsis columnifera*, Stewart. The tube differs from that of the latter in being traversed by nine instead of four canals; but this may merely represent a difference in age, for in *Disyringa dissimilis*, Ridley, stages of four, eight, and sixteen canals are known to exist.

This explanation is consistent with the greater diameter of Marshall's specimens, which measure 55 mm. in length by 15 mm. in width, just twice the width of that in Stewart's specimen. The nine canals of Marshall are possibly reducible to eight, since the axial canal may be merely a cleavage fissure.

In comparing the cloacal tube with that of *Disyringa dissimilis* in the stage of eight, one will observe that the eight canals of the latter are of unequal value, four are primary and four secondary, and the latter are nearer the periphery than the former. This is not the case in Marshall's specimens, in which all the eight tubes are of equal value, and all radiate from the centre to the circumference.

There appears to be greater variety in the cloacal megascleres of *Tethyopsis radiata* than in *Tethyopsis columnifera;* but this may be explained by the fact that, owing to the existence of only a single specimen of the latter, it has not been so completely examined.

Another explanation is also possible. Marshall alludes to the difficulty of obtaining preparations of the spicules of the sponge; and though I think it unlikely, yet I cannot avoid making the suggestion that some of the forms figured by Marshall may be fragments of orthotriænes.

Stryphnus carbonarius (O. Schmidt).

Stelletta carbonaria, O. Schmidt, Archiv f. mikrosk. Anat., Bd. xviii. p. 280, 1880.
„ „ Weltner, Inaug. Diss., p. 52, pl. iii. fig. 42, 1882.

Sponge.—Massive, irregular, of slag-like appearance.

Spicules.—I. Megascleres. 1. *Oxea*. 2. *Strongloxea* (?). 3. *Dichotriæne;* rhabdome, slender, short.

II. Microscleres. 4. *Oxyaster*, actines slender. 5. *Sanidaster*.[1]

Colour.—Black. Size (?).

Habitat.—Gulf of Naples.

Remarks.—I have not seen specimens of this sponge, but from Schmidt's description it would appear to be a genuine *Stryphnus;* whether identical or not with *Stryphnus mucronatus*, O. Schmidt, must for the present be regarded as more or less doubtful; the only difference to be gathered from Schmidt's description lies in the colour, the last-named species being puce-brown, according to Schmidt.

Stryphnus fortis, Vosmaer.

Stelletta fortis, Vosmaer, Spong. "Willem Barents," p. 6, pl. iv. figs. 32, 33; pl. v. figs. 48, 49, 1885.

Sponge.—Massive; neither oscules nor wide canals visible; surface very rough, with protruding spicules.

Spicules.—I. Megascleres. 1. *Oxea*, large. 2. *Plagiotriæne*, rhabdome frequently only twice the length of the cladi.

II. Microscleres. 3. *Oxyaster*, comparatively large. 4. *Amphiaster*, small.

Colour.—Brownish-red.

Habitat.—Lat. 71° 55′ N., long. 20° 31′ E.; depth, 179 fathoms.

Remarks.—Vosmaer compares this species with *Ecionema compressa*, Bwk., which, however, is really a *Pœcillastra*. It is true *Pœcillastra* and *Stryphnus* appear to be allied through the genus *Characella;* but Vosmaer's description, though inadequate for the determination of species, owing to the absence of measurements, can leave no doubt as to the generic characters of the species he had under observation; it is clearly a *Stryphnus*, and closely allied to *Stryphnus* (*Ecionema*) *ponderosus*, Bwk. Perhaps this is the species to which Vosmaer intended to allude. Still closer probably are its affinities to *Stryphnus rudis* from Norway.

[1] See Weltner, *loc. cit.*, pl. iii. fig. 42.

Stryphnus mucronatus (O. Schmidt).

Stelletta mucronata, O. Schmidt, Spong. Küste v. Algier, p. 19, pl. iv. fig. 2, 1868.

Sponge.—"The example is about the size of a walnut."—O. Sch.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 2·3 by 0·055 mm. 2. *Dichotriæne*, small, rhabdome variable in size, sometimes 0·25 by 0·02 mm., less frequently 0·382 mm. in length; protocladi in examples with the shorter rhabdome 0·0275 mm. in length.

II. Microscleres. 3. *Oxyaster*, actines from four to nine in number, slender, conical, about 0·02 mm. in length. 4. *Amphiaster*, axis short, rod-like, 0·008 mm. in length, actines short, bacillary, strongylate, sometimes confined to the termination of the axis, more frequently also proceeding from the sides, the spicule then not distinguishable from a sanidaster; total length, 0·016 mm.

Colour.—Puce-brown.

Habitat.—Coast of Algiers.

Remarks.—I received from Professor Perrier, while this Report was passing through the press, a fragment of the above sponge; it is not only an evident *Stryphnus*, but remarkably similar to my species *Stryphnus niger*, from Port Jackson, though no one from Schmidt's description would have guessed as much; so altogether inadequate is this description that, in the event of the two species proving identical, it will be only just to apply the rule, that priority can only be claimed for species which can be recognised from their description, otherwise one might as well at once admit MS. names as sufficient; and a large proportion of Schmidt's species are nothing but MS. names, with a word or two of explanation by way of apology.

Stryphnus ponderosus (Bowerbank).

Ecionema ponderosa, Bowerbank, Mon. Brit. Spong., vol. ii. p. 56, 1866; vol. iii. p. 18, pl. viii. figs. 8–15, 1874; vol. iv. p. 30, 1882.

Stelletta aspera, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. vii. p. 7, pl. iv. figs. 7–11, 1871.

Ecionema ponderosa, Carter, *op. cit.*, ser. 5, vol. xi. p. 349, 1883.

Sponge.—Massive, lobate, sessile; surface smooth; oscules dispersed; pores (?).

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 1·625 mm. (B.), 2·5 mm. (C.) long. 2. *Dichotriæne*, rhabdome 0·34 mm. (B.), 0·825 mm. (C.) long.

II. Microscleres. 3. *Ectosomal amphiaster*, 0·0075 mm. (B.), 0·0125 mm. (C.) long. 4. *Choanosomal oxyaster*, 0·0075 mm. (B.), 0·025 mm. (C.) in diameter. (B. signifies measurements obtained from Bowerbank's illustrations, C. from Carter's description. I have not had an opportunity of making direct measurements.)

Colour.—Purplish-black in the fresh state; nut-brown when dry.

Habitat.—Guernsey (Norman), Devonshire (Carter).

Remarks.—Norman[1] first pointed out the similarity of *Ecionema ponderosa*, Bk., and *Stelletta aspera*, Crtr., at the same time stating that the only spicules of Bowerbank's sponge absent from Carter's are certain "cylindro-doliolate" forms which Bowerbank had the acumen to observe, but which might have easily been overlooked by Carter; as this supposed form of spicule is introduced into Bowerbank's descriptions of various other species of sponge,[2] it may be as well to mention here that the "cylindro-doliolates" are nothing else than short cylindrical fragments of oxeate spicules; they are not uncommon in mountings of sponge spicules, and almost always, if not invariably, present one or two transverse cracks in the middle, which, as well as the general characters of the broken bits, are faithfully represented in Bowerbank's drawings.

Stryphnus rudis, n. sp.

Sponge.—Large, massive, depressed, irregularly lobate; oscules in irregular sieves at the ends of the lobes, and on the under surface; surface densely and coarsely hispid.

Spicules.—I. Megascleres. 1. *Ectosomal oxea*, fusiform, attenuately pointed, 7·0 by 0·0725 mm.; *Choanosomal oxea*, similar, 2·86 by 0·064 to 3·03 by 0·055 mm.

2. *Plagiotriæne*, rhabdome straight, conical; cladi conical, curving outwards and forwards, giving a cup-like outline to the cladome; dimensions variable. Rhabdome 1·24 by 0·67 mm., cladi 0·716 mm., chord 0·954 mm.; and rhabdome 1·03 by 0·084 mm., cladi 0·876 mm., and chord 1·27 mm.

3. *Dichotriæne*, rhabdome 1·033 by 0·045 mm., protocladi 0·16 mm., deuterocladi 0·366 mm. long. Transitional forms occur between this form and the plagiotriæne; in an example with two bifurcate cladi and one simple cladus, the dimensions are—rhabdome 1·45 by 0·064 mm., simple cladus 0·621 mm., protocladi 0·223 mm., and deuterocladi 0·366 mm. long. The esactine of the triænes is frequently cladose near its extremity, and sometimes dichocladi proceed from it at right angles.

II. Microscleres. 4. *Ectosomal amphiaster*, from 0·012 to 0·016 mm. in length; actines about 0·005 mm. long.

5. *Choanosomal oxyaster*, centrum absent, actines not numerous, slender, conical, from 0·024 to 0·032 mm. in length.

Colour.—Blackish-brown.

Habitat.—Kors Fjord, Norway (Rev. A. M. Norman).

Remarks.—The single specimen of this sponge measures 200 mm. in length, 160 mm. in breadth, and 85 mm. in height. The excurrent canals cross the cake-like mass from the upper to the lower surface, and run longitudinally through the lobes; they are of

[1] Bowerbank, Mon. Brit. Spong., vol. iv. p. 30.

[2] *E.g.*, in *Geodia media*, Bwk., *Proc. Zool. Soc. Lond.*, 1873, pl. ii. fig. 29.

considerable width, from 3 to 4 mm., and expanding beneath the cortex, open by oscules much smaller than themselves, from 1 to 2 mm. in diameter.

Stryphnus unguiculus, Sollas (Pl. XV. figs. 33–39).

Stryphnus unguiculus, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 193, 1886.

Sponge.—Compound, massive, spreading horizontally into irregular lobes, and rising into mound-like eminences; base torn, but apparently free; oscules evident in groups at the ends of the lobes or on the summits of the mounds; excurrent canals large, running longitudinally through the lobes, expanding beneath the oscules, and opening into them by chones, of which there are several to each canal. Pores generally distributed.

Spicules.—I. Megascleres. 1. *Somal oxea* (Pl. XV. fig. 33), fusiform, usually curved, variously but usually obtusely pointed, 2·68 by 0·095 mm.

2. *Ectosomal oxea*, hispidating the surface, fusiform, much attenuated towards the ends as though to terminate in a sharp point, but usually rounded off, 5·712 by 0·087 mm.

3. *Dichotriæne* (Pl. XV. figs. 34, 35), rhabdome conical, obtusely pointed or rounded off at the end; protocladi projecting only slightly forwards; deuterocladi directed backwards, and after diverging from each other in the usual manner approximating so as to become parallel for the latter half of their course. Rhabdome 0·508 by 0·0316 mm., protocladi 0·0276 mm., deuterocladi 0·0395 mm. long, chord of deuterocladi 0·0237 mm.

II. Microscleres. 4. *Somal amphiaster*, typical form as in *Stryphnus niger;* but varieties are, if possible, more numerous.

5. *Choanosomal oxyaster*, a small centrum, and sharp, conical, smooth or roughened actines, which, though usually numerous, are frequently reduced to six, five, four, three, two, or even one in number. A single actine 0·0197 mm. long.

Colour.—Deep brown externally, dark grey within.

Habitat.—Port Elizabeth, South Africa (according to the dealer from whom it was purchased).

Remarks.—This species is very similar to *Stryphnus niger;* it is distinguished by the claw-like cladi of the dichotriæne.

Subfamily 4. Rhabdasterina.

Genus 15. *Ecionema*, Bowerbank.

Rhabdastrose Stellettidæ in which the ectosome does not form a cortex, with two forms of microscleres, one of them being a microrabd, derived either from an anthaster or a chiaster by reduction in the number of the actines to two.

Ecionema acervus, Bowerbank.

Ecionema acervus, Bowerbank, Brit. Spong., vol. i. p. 173, pl. xxviii. fig. 355, 1864; Proc. Zool. Soc. Lond., p. 322, pl. xxx. figs. 1–6, 1873. *Non* Ridley, Spong. "Alert," p. 627.

Sponge.—Pear-shaped, massive, pedicelled (?); surface even, minutely hispid; oscules dispersed.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, abruptly pointed, 4·0 by 0·067 mm.; the oxeas occurring in the axis of the sponge are smaller, 2·7 by 0·084 mm. 2. *Orthotriæne*, rhabdome, esactine strongylate, 3·03 by 0·084 mm., cladi 0·270 mm. in length. 3. *Anatriæne*, rhabdome 4·0 by 0·029 mm., cladi 0·097 mm., chord 0·116 mm. long.

II. Microscleres. 4. *Microstrongyle*, fusiform, 0·009 by 0·0026 mm. 5. *Chiaster*, with terminally tylote actines, 0·008 mm. in diameter. 6. *Spheraster*, 0·008 mm. in diameter.

Colour.—Dark brown in the dried state.

Habitat.—Fiji.

Remarks.—The sponge measures 56 mm. in height by 48 mm. in width; the base is broken off. The microstrongyles, usually smooth and not spined, form a layer beneath the outer epithelium, and are the predominant microsclere of the choanosome also. Minute oxeas are present in the ectosome; I have no note of their dimensions.

Ecionema australiense (Carter).

Stelletta australiensis, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xi. p. 350, pl. xiv. fig. 2, 1883.

Sponge.—Large; ectosome thin; oscules and pores (?).

Spicules.—I. Megascleres. 1. *Somal oxea*, sometimes a strongyle, 2·18 by 0·055 mm. 2. *Ectosomal oxea*, 0·5 by 0·006 mm. 3. *Protriæne*, rhabdome pointed, or frequently strongylate; cladi also pointed or strongylate. Rhabdome 2·22 by 0·05 mm., cladi 0·2 mm., chord from 0·095 to 0·16 mm. long. 4. *Anatriæne*, rhabdome pointed or strongylate, 2·22 by 0·013 mm.; cladi short, frequently strongylate, 0·032 mm. in length.

II. Microscleres. 5. *Microstrongyle*, fusiform or cylindrical, faintly centrotylote, 0·009 mm. in length. 6. *Chiaster*, actines slender, hair-like, terminally tylote, a minute spherical centrum sometimes present, total diameter, 0·012 mm.

Colour.—(?) Size, 300 mm. in height by 187·5 mm. broad, and 75 mm. thick at the base.

Habitat.—Freemantle, west coast of Australia.

Remarks.—Mr. Carter has kindly afforded me an opportunity of examining mounted preparations of this species; it is an evident *Ecionema*, and represents in that genus the species *Anthastra ridleyi* amongst the *Anthastræ*.

The curious tendency to a strongylate termination exhibited by the actines and cladi is a strongly marked feature.

Ecionema bacilliferum, var. *robustum* (Carter).

Stelletta bacillifera, var. *robusta*, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xi. p. 351, pl. xiv. fig. 3, 1883, and *op. cit.*, vol. xvii. p. 123, 1886.

Sponge.—Large, conical, compressed; oscules large, few; pores in sieves.

Spicules.—I. Megascleres. 1. *Somal oxea*, fusiform, 1·3 by 0·025 mm. 2. *Ectosomal oxea*, 0·15 by 0·01 mm. 3. *Orthotriæne*, rhabdome sharply pointed but frequently strongylate, 1·52 by 0·028 mm.; cladi 0·13 mm. long. 4. *Anatriæne*, rhabdome 1·16 by 0·026 mm., cladi 0·065 mm., chord 0·116 mm., sagitta 0·045 mm. in length.

II. Microscleres. 5. *Microstrongyle*, either smooth, cylindrical, or more or less fusiform, and covered with small, erect, conical spines, when it is indistinguishable from a reduced anthaster. The smooth form is traversed by an axial fibre, which no doubt is also present in the spined variety, where, however, it is obscured by the presence of the spines; 0·045 mm. long. 6. *Chiaster*, actines slender, terminally tylote or not, a minute, spherical centrum sometimes present; 0·008 to 0·012 mm. in diameter.

Colour.—(?) Size, 100 mm. in height by 150 mm. in diameter at the summit, and 75 mm. at the base.

Habitat.—Ports Elliot and Adelaide, Australia.

Ecionema densum, Bowerbank.

Ecionema densum, Bowerbank, Proc. Zool. Soc. Lond., p. 323, pl. xxx. figs. 7–14, 1873.

Sponge.—Massive or subcyathiform, sessile; surface rough, uneven, sinuous; oscules simple, dispersed.

Spicules.—I. Megascleres. 1. *Strongyle*, cylindrical, 1·68 by 0·035 mm. 2. *Plagiotriæne*, rhabdome, esactine strongylate, 1·43 by 0·04 mm.; cladi strongylate, 0·0774 mm. long; chord 0·129 mm. long.

II. Microscleres. 3. *Microstrongyle*, fusiform, tuberculate, 0·0118 by 0·004 mm. 4. *Oxeate spheraster*, centrum small, actines conical, oxeate, bearing erect, conical spines. 5. *Strongylate spheraster*, centrum large; actines bacillary, strongylate, 0·023 mm. in diameter.

Colour.—Ochreous-yellow in the dried state.

Habitat.—Fiji Islands.

Remarks.—This species is founded on a single example, 56 mm. in height and 50 mm. in width. The ectosome is not a cortex, and beneath the outer epithelium is a layer of microstrongyles; no other microscleres occur in this layer.

Ecionema nigrum, n. sp.

Sponge.—Massive, lobate, ridged; surface even.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, frequently bent at the middle, sharply pointed, 2·4 by 0·058 mm.

2. *Plagiotriæne*, rhabdome conical, sharply pointed, 2·86 by 0·058 mm., cladi 0·27 mm. long.

3. *Anatriæne*, rhabdome cylindrical, sharply pointed or strongylate, 3·18 by 0·015 mm., cladi 0·0516 mm., chord 0·0775 mm., sagitta 0·039 mm. long.

II. Microscleres. 4. *Microstrongyle*, fusiform, centrotylote, smooth or roughened, 0·001 mm. long.

5. *Chiaster*, slender, terminally tylote actines, 0·016 mm. in diameter.

Colour.—Surface black, interior greyish.

Habitat.—West Coast of Africa; a fragment of this sponge was given me by Professor Stewart for description from the collection of the Royal College of Surgeons, London.

Ecionema rotundum, n. n.

Ecionema acervus, Ridley, Spong. "Alert," p. 627, 1884 (*non* Bowerbank).

Sponge.—Ovate, free.

Spicules.—I. Megascleres. 1. *Oxea*, stout, fusiform, bent, somewhat abruptly pointed, 2·1 by 0·059 mm. 2. *Plagiotriæne*, rhabdome conical, 1·6 by 0·05 mm., cladi 0·2 mm. in length. 3. *Anatriæne*, rhabdome 20 by 0·013 mm., cladi 0·058 mm.; cladome flattened in front, cladi 0·128 mm., chord 0·128 mm., sagitta 0·0954 mm. in length.

II. Microscleres. 4. *Microstrongyle*, fusiform, sometimes faintly centrotylote, surface minutely roughened, 0·016 mm. in length. 5. *Chiaster*, centrum absent, actines slender, bacillary, terminally tylote, 0·012 mm. in total diameter.

Habitat.—Etoile, Amirante Group; depth, 13 fathoms.

Remarks.—The distinction of this species from *Ecionema acervus*, Bwk., depends on the size of the spicules, the megascleres in Bowerbank's species being considerably larger than those in Ridley's.

Genus 16. *Papyrula*, O. Schmidt.

Papyrula, Oscar Schmidt, Spong. Adriat. Meeres, Suppl., iv. p. 18, 1868.

Rhabdasterose Stellettidæ in which one of the microscleres is a microrabd (microxea), the other an aster. The microxeas are scattered through the choanosome, and densely crowded in the thin ectosome.

This genus is evidently similar to *Ecionema*, but I retain it provisionally on account of the difference between the microxea which distinguishes it and the microstrongyle of the latter. The Ecionemid microstrongyle is probably derived from a minute aster, and does not exhibit an axial fibre, the *Papyrula* microxea is probably derived from a large aster, and does exhibit an axial fibre. If this distinction should hold good, the species *Ecionema bacilliferum*, var. *obtusum*, Carter, would have to be included in *Papyrula*, since the microstrongyle which characterises it presents an evident axial fibre, and has been derived, not from the chiaster, but from the comparatively large anthaster.

Papyrula helleri (O. Schmidt).

Stelletta helleri, O. Schmidt, Spong. Adriat. Meeres, Suppl., i. p. 32, pl. iii. fig. 8, 1864.

Sponge.—Amorphous, surface smooth, cortex thin, cortical skeleton consisting of centrotylote microxeas.

Spicules.—I. Megascleres. 1. *Oxea*, 1·43 by 0·039 mm.

2. *Dichotriæne*, rhabdome proximally strongylate, 0·4 by 0·035 mm., protocladi 0·06 to 0·09 mm. long, deuterocladi 0·19 to 0·24 mm. long.

II. Microscleres. 3. *Microxea*, fusiform, centrotylote, 0·032 to 0·15 mm. by 0·006 mm.

4. *Oxyaster*, centrum small, confluent with the conical actines, a single actine 0·02 mm. in length.

Colour.—Black.

Habitat.—Lissa, Adriatic; depth, 35 fathoms.

Papyrula candidata, O. Schmidt.

Papyrula candidata, Oscar Schmidt, Spong. Adriat. Meeres, Suppl., iii. p. 18, pl. iv. fig. 1, 1868.

Sponge growing in irregular rounded masses about 30 mm. in diameter. Cortex of the thinness of paper.

Spicules.—I. Megascleres. 1. *Oxea*, slender, 0·816 mm. in length.

2. *Dichotriæne*, rhabdome short, protocladus 0·071 mm. in length, deuterocladus 0·1775 mm. in length.

II. Microscleres. 3. *Microxea*, centrotylote or not, from 0·05 to 0·25 mm. in length.

Colour.—White externally, yellowish-green within.

Habitat.—Coast of Algiers.

The measurements of the spicules are based on mounted preparations presented by Schmidt to the British Museum, and are therefore unreliable. Schmidt gives the size of

the ectosomal microxea as 0·05 mm. in length. Schmidt concludes his brief description with the remark that the sponge is "incontestibly very nearly related to *Stelletta helleri*, O. S., and would be identical with it, but for the absence of asters. One is right in the meanwhile in distinguishing the forms by particular names." As Oscar Schmidt showed remarkable facility in overlooking the minute spicules of a sponge, it would appear from this that the separation of the two species rests on very slender grounds.

Psammastra geodides (Carter).

Stelletta geodides, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xviii. p. 125, 1886.

Sponge.—Subspherical, sessile; surface minutely granulated, over low mulberry-like elevations; oscules small, numerous, situated in the grooves between the elevations. Cortex, 1 mm. in thickness, consisting of a collenchymatous outer portion, 0·92 mm. in thickness, widely excavated by intercortical cavities, and an inner fibrous portion, 2·6 mm. in thickness.

Spicules.—I. Megascleres. 1. *Oxea*, 2·5 by 0·025 mm. 2. *Plagiotriæne*, rhabdome 1·56 by 0·025 mm., chord 0·083 mm. long.

II. Microscleres. 3. *Microstrongyle*, ellipsoidal, minutely spined, 0·0083 by 0·0028 mm. 4. *Oxyaster*, centrum small, actines conical, 0·021 mm. in diameter.

Colour.—Dark slate tint, both fresh and in spirits. Size, 63 mm. in diameter.

Habitat.—Port Phillip Heads, South Australia; depth, 13 fathoms.

Remarks.—Mr. Carter kindly sent me tracings illustrating the structure of this sponge; these clearly show it to be an *Ecionema* with a cortex, and this it appears to me is the essential character of *Psammastra*, to which genus consequently I have assigned it. It differs from *Psammastra murrayi* in many respects; the conules are absent or only represented by the "low mulberry-like elevations," and there are no grains of sand in the cortex. The triæne is very similar to that of *Psammastra murrayi*, as is the oxea, but both are much smaller.

Genus 17. *Algol*,[1] n. gen.

Rhabdastrose Stellettidæ possessing spicules like those of *Ecionema*, arranged like those of *Stryphnus*.

Algol corticata (Carter.)

Stellettinopsis corticata, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. iii. p. 348, pl. xxviii. figs. 10–15, 1879.

Sponge.—Globular, sessile; surface smooth, even; oscules numerous, chiefly congregated at the summit; pores in sieves.

[1] The name of a star.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform or cylindrical, sometimes tornote, 1·136 by 0·014 mm.

2. *Orthotriæne*, rhabdome oxeate or strongylate, cladi of variable and unequal length, usually strongylate, straight or reflexed. Rhabdome 0·75 mm. and over in length by 0·0135 mm., cladi from 0·009 to 0·045 mm. long.

II. Microscleres. 3. *Chiaster*, centrum small or absent, actines slender cylindrical, terminally truncate or minutely tylote, 0·0125 mm. in diameter.

4. *Microstrongyle*, cylindrical, entirely spined, spines small, conical, erect, 0·04 by 0·0042 mm. This spicule is traversed by a distinct axial canal.

Colour.—Yellowish-brown in the dried state. Size, 33 mm. high by 37 mm. in diameter.

Habitat.—Port Adelaide, Australia.

Remarks.—The ectosome is thin, about 0·5 mm. in thickness. The oxeas are partly aggregated into distinct fibres, which radiate to the surface, partly loosely scattered through the sponge. In the ectosome they lie tangentially. The triænes occur along with the oxeas of the fibres, lying parallel with them; from their comparative rarity and the variability and shortness of their cladi they appear to be undergoing a process of crowding out. The cladi are sometimes all three reduced to a length less than the diameter of the rhabdome, sometimes a cladus may attain a length of 0·045 mm., and the remaining two only half this, 0·023 mm.; sometimes one cladus may be absent altogether, only two remaining. When first I met with one of these spicules I imagined that it might be of extraneous origin, since the sponge has a habit of embedding foreign bodies, such as sand grains, in the ectosome; subsequent examination proved that this could not be the case; the triænes are too numerous, too fresh, and too exactly similar in position to the triænes which occur in undoubted triænose sponges for such an explanation to be tenable.

The discovery of triænes in a sponge where they had escaped the lynx-eyed acuteness of Carter, who founded a new genus on their supposed absence, may well impress us with the untrustworthy nature of negative evidence, and has led me to examine and re-examine afresh such sponges as *Asteropus*, in which I have myself stated their absence, and although I have not succeeded in finding them, it by no means follows that no one else will.

Although the definition given by Carter of the genus *Stellettinopsis* breaks down in its application to the typical species, yet there are other sponges to which it still applies good; and the question arises whether we are to retain the name of the genus in connection with the definition or in connection with the typical species. It would obviously be more convenient to adopt the former alternative; but there is a third course open, and that is to suppress the name altogether; indeed, from this I see no escape. The

word *Stellettinopsis* is an odious combination of Greek and bad Latin, and hybrid names such as this are expressly condemned by the Stricklandian rules. I therefore propose a fresh definition and a new name for the type, and a fresh type and a new name for the definition.

Genus (?).

Stelletta pathologica, O. Schmidt.

Stelletta pathologica, O. Schmidt, Spong. Küste v. Algier, p. 19, pl. iii. figs. 3, 4, 1868.

Sponge.—Irregular knoll-like masses with a rough surface, cortex 0·5 mm. in thickness, not differentiated into two layers, apparently collenchymatous.

Spicules.—I. Megascleres. 1. *Oxea*, long, slender, very attenuately pointed, collected in loose fibre-like bundles, which are directed at right angles to the cortex, 2·38 by 0·012 mm. 2. *Mesotriænes* (*vide* pl. iii. fig. 3*a*, *loc. cit.*), rhabdal actines conical, oxeate, 0·875 mm. by 0·0434 mm., cladi conical, oxeate, variously inclined to the axis of the rhabdome, subject to numerous irregularities in form, number, and position, frequently reduced to two or one in number, and about 0·238 mm. in length.

II. Microscleres. 3. *Oxyaster*, actines conical, oxeate, 0·08 mm. in length, variable in number and in other respects, sometimes reduced to microcalthrops, sometimes to microxea, frequently very irregular in form, often reproducing the forms of the mesotriæne. 4. *Spheraster*, actines conical, strongylate, often rough or tubercular, confluent with the centrum, total diameter 0·0195 mm., numerous.

Habitat.—Coast of Algiers.

Remarks.—I owe to the kindness of Professor Perrier a fragment of this interesting sponge, but it reached me too late for insertion in its proper place, if, indeed, this, in the present state of our knowledge, can be determined; the cortex is not fibrous and resembles that of *Aurora;* pores or oscules I have not seen; and from the character of the cortex I should not expect to find chones; the mesotriæne is scattered through the whole sponge, with a general tendency to lie parallel to the coarse loose bundles of oxeas; the microscleres are generally distributed throughout the whole sponge.

It appears to me that the mesotriæne may be regarded as a modified orthotriæne, which has acquired the habit of growing to maturity within the choanosome, and thus presenting among the Stellettidæ an analogue to *Pœcillastra* among the Theneidæ. The only other sponge in which mesotriænes are characteristically present is *Triptolemus*, but in this the microscleres are of different character.

The characters of the chamber system and of the choanosomal mesoderm are not known, and till our knowledge of the sponge is more extensive I regard its precise position as uncertain.

Species Insufficiently Characterised.

Myriastra (?) or *Anthastra* (?) *tethyopsis* (Carter).

Stelletta tethyopsis, Carter, Ann. and Mag. Nat. Hist., vol. vi. p. 491, pl. vi. figs. 39, 40, 1880.

Sponge.—Somewhat spherical and free, or hemispherical and sessile, surface hispid by projection of triænes. Oscules (?). Cortex (?).

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, 8·68 by 0·056 mm. 2. *Dichotriæne*, rhabdome 8·68 by 0·07 mm., chord 0·42 mm. 3. *Protriæne*, hispidating. 4. *Anatriæne*, hispidating.

II. Microscleres. 5. *Chiaster*, 0·0042 mm. in diameter. 6. *Chiaster*, 0·0162 mm. in diameter.

Colour.—Grey.

Habitat.—Gulf of Manaar.

Stelletta (?) *profunditatis*, O. Schmidt.

Stelletta profunditatis, O. Schmidt, Spong. Mexico, p. 70, 1880.

Sponge.—Bolster shape, 10 mm. in diameter, 5 mm. high.

Spicules.—I. Megascleres. 1. *Rhabdus*, either oxeate, strongyloxeate, or tylotoxeate. 2. *Dichotriæne*, with slender, widely divergent cladi.

II. Microsclere. 3. *Oxyaster*, with four to seven slender actines.

Habitat.—Lat. 24° 33′ N., long. 84° 23′ W.; depth, 1920 fathoms.

Ecionema (?) *pygmæorum* (O. Schmidt).

Stelletta pygmæorum, O. Schmidt, Spong. Mexico, p. 70, pl. ix. fig. 9, 1880.

Sponge.—Resembling an irregular crooked stem of a plant, with a club-like upper portion, circular in transverse section.

Spicules.—I. Megascleres. 1. *Oxea*, sharply or obtusely pointed. 2. *Orthotriænes* and *Dichotriænes*, cladi irregular in form and frequently reduced to tubercles.

II. Microscleres. 3. *Microstrongyle.* 4. *Aster*, 0·0028 to 0·0058 mm. in diameter. The microscleres form a cortical layer.

Habitat.—St. Vincent; depth, 95 fathoms.

Ancorina (?) *tripodaria*, O. Schmidt.

Ancorina tripodaria, O. Schmidt, Spong. Adriat. Meer., Suppl., iii. p. 18, pl. iii. fig. 10, 1868.

Sponge.—Half the size of a hand, with a thick cortex.

Spicules.—I. Megascleres. 1. *Oxea*, slender, with a roughened surface. 2. *Oxea*, smooth, straight, or bent. 3. *Plagiotriæne*, rhabdome comparatively short; cladi long,

slender, curving outwards and forwards, so as to give a cup-like outline to the cladome, sometimes reduced to tubercles.

II. Microscleres (?).

Habitat.—Coast of Algiers.

Remarks.—From the character of the plagiotriæne I suspect this may prove to be a *Stryphnus*.

Ancorina individuosa, O. Schmidt.

Ancorina individuosa, O. Sch., Spong. Atlant. Gebiet., p. 67, 1870.

Genus (?).

Stelletta fibulifera, O. Schmidt.

Stelletta fibulifera, O. Schmidt, Archiv f. mikrosk. Anat., vol. xviii. p. 280, 1880.

Sponge.—Irregular, amorphous.

Spicules.—I. Megascleres. 1. *Strongyle*, comparatively large. 2. *Strongyle*, very fine, slender. 3. *Triæne*, with simple cladi.

II. Microscleres. 4. *Sigma* (?), "hooks like those of the Desmacidinæ." 5. *Euaster*, "stellates with conical actines." 6. *Spiraster* (?).

Habitat.—Gulf of Naples.

Remarks.—One cannot avoid the suspicion that some error must have vitiated Schmidt's description; such a remarkable complement of microscleres occurs in no other known sponge, and considering the frequency with which sponges incorporate the spicules of other species, it would appear probable that this is either a Stellettid in which sigmas, or a Tetillid in which asters, are accidentally present; the former is the more probable alternative.

Species which have been removed from the Family Stellettidæ.

The following species are referable to the genus *Erylus* of the family Geodiidæ:—

Stelletta discophora, O. Sch., Spong. Adriat. Meer., p. 47, 1862.
Stelletta mammillaris, O. Sch., *Ibid.*, p. 48, and Suppl., iii. p. 20, 1868.
Stelletta euastrum, O. Sch., Spong. Adriat. Meer., Suppl., iii. p. 20.
Stelletta intermedia, O. Sch., *Ibid.*, p. 21.
Stelletta transiens, Weltner, Inaug. Diss., p. 44, 1882.

The following species is referable to the subfamily Geodina of the family Geodiidæ.

Stelletta geodina, O. Sch., Spong. Adriat. Meer., Suppl., iii. p. 20.

The following species are referred to the Theneidæ :—

Stelletta agariciformis, O. Sch., Spong. Atlant. Gebiet., p. 68, 1870.
Stelletta scabra, O. Sch., Spong. Adriat. Meer., Suppl., iii. p. 19 (probably).

Stelletta nux, Selenka,[1] regarded by Vosmaer[2] as a *Stelletta*, but not by Ridley, who regards it as a *Tethya*,[3] is really, as slides of mounted spicules presented by Selenka to Dr. E. Perceval Wright prove, a species of Geodine sponge, nearly related to *Cydonium globostellata*, Carter, or *Cydonium eosaster*, Sollas, with one of which indeed it may be identical.

Stelletta bacca, Selenka,[4] which Vosmaer correctly excludes from *Stelletta*, while Ridley[5] includes it, is, as mounted preparations show, identical with *Tetilla merguiensis*, Carter.

Ancorina aaptos, O. Sch.,[6] is a Suberite. Schmidt in one of his latest writings[7] admits that it must be excluded from the Tetractinellida.

Ancorina sigmatophora, O. Sch.[8] A slide bearing mounted spicules of this sponge was kindly sent me by Dr. Zeigler, but did not reach me in time for notice in its proper place; it is evidently a member of the Tetillidæ, and probably allied to *Tetilla australiensis*, Carter, or *Tetilla merguiensis*, Carter. It possesses two forms of microsclere, one the usual sigmaspire, and the other a microxea, the megascleres include an oxea, protriæne, and anatriæne.

Ancorina pachastrelloides, O. Sch.,[9] would appear to belong to the Pachastrellida, but like *Ancorina sigmatophora*, it is insufficently characterised.

Appendix to the Euastrosa.

Family Epipolasidæ.

Genus *Asteropus*,[10] n. gen.

Epipolasidæ resembling *Stryphnus*, from which they differ only by the absence of a triæne.

Asteropus simplex (Carter).

Stellettinopsis simplex, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. iii. p. 349, pl. xxviii. figs. 16–18, 1879.

Sponge.—Massive, convex, lobate, sessile; surface even, irregularly undulating; oscules grouped in a depression on the lower surface.

[1] *Zeitschr. f. wiss. Zool.*, Bd. xvii. p. 569, pl. xxxv. figs. 11–13, 1867.
[2] Bronn's Thierreich, Porifera, p. 319.
[3] Voyage of the "Alert," p. 472, footnote.
[4] *Zeitschr. f. wiss. Zool.*, *loc. cit.*, pl. xxxv. figs. 14, 15.
[5] *Loc. cit.*, p. 472.
[6] Spong. Adriat. Meer., Suppl., p. 17, 1864.
[7] *Zeitschr. f. wiss. Zool.*, Bd. xlii. p. 641, 1885.
[8] Spong. Atlant. Gebiet., p. 67, 1870.
[9] *Ibid.*, p. 68.
[10] ἀστεροπός, starry.

Spicules.—I. Megasclere. 1. *Oxea*, fusiform, curved, 1·32 by 0·028 mm.

II. Microscleres. 2. *Oxyaster*, very variable, centrum small, sometimes absent, actines conical, minutely spined, from one to twelve in number; size variable, smaller as the actines are more numerous, maximum diameter 0·06 mm.

3. *Sanidasters*, exceedingly variable, the more regular and usually smaller forms presenting a straight axis subdivided into two or more spines at the end, and bearing two whorls of spines situated about one-third the length of the axis from each end; the less regular present the same grotesque appearance as characterises the similar spicule in *Stryphnus unguiculus;* length 0·017 mm.

Colour.—Tawny-brown. Size, 63 mm. in length by 25 mm. in height.

Habitat.—Freemantle, Australia.

Remarks.—The spicules of this species remind one of those of *Stryphnus;* and in this genus there are species in which the triæne is both rare and small relatively to the oxea. If *Asteropus* is a reduced Stellettid it is to *Stryphnus* that we must look for its nearest alliance. In a type slide of the species kindly furnished me by Mr. Carter, I observed more than one oxea which presented a sudden flexure near the end, so as to present a form very similar to the reduced triænes of some Tetillid species (*Chrotella macellata*). In such promonænes the axial fibre stops short, and is slightly enlarged at the point of flexure, and then recommences as a distinct branch to supply what is practically a single cladus.

Asteropus (?) *annulatus* (O. Schmidt).

Stellettinopsis annulata, O. Sch., Spong. Mexico, p. 75, pl. ix. fig. 6, 1880.

Sponge.—Incrusting.

Spicules.—I. Megasclere. 1. *Oxea*, long and slender.

II. Microscleres. 2. *Microxea* (?), short, stout. 3. *Spiraster* (?). 4. *Oxyaster*, centrum absent; actines transversely ridged and tubercled.

Habitat.—Gulf of Mexico, on *Farrea.*

Remarks.—I have not seen specimens of this sponge. Its generic position is doubtful, If the spiraster so called should prove to be a sanidaster, it would naturally lead to the inclusion of the sponge in the genus to which it is here assigned.

Genus *Coppatias*,[1] n. gen.

Epipolasidæ in which but one form of aster, and that a euaster, is present. Canal system unknown.

[1] κοππᾶτίας, branded with the letter koppa (ϟ). The circle is fancifully supposed to represent the aster, the stroke the rhabdus, of this group of sponges.

Coppatias coriaceus (Carter).

Stellettinopsis coriacea, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xvii. p. 126, 1886.

Sponge.—A large irregular fragment enclosing large bivalve shells in its substance. Surface smooth; ectosome thick. Oscules in small groups, irregularly distributed.

Spicules.—I. Megasclere. 1. *Rhabdus* sometimes an oxea, sometimes a strongyl-oxea, 1·35 by 0·0187 mm.

II. Microscleres. 2. *Microxea*, 0·104 mm. in length. 3. *Euaster*, 0·0083 mm. in diameter.

Colour.—Dull purple when alive. Size, a fragment 75 mm. in diameter.

Habitat.—South Australia; depth, 20 fathoms.

Coppatias tuberculatus (Carter).

Stellettinopsis tuberculata, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xvii. p. 126, 1886.

Sponge.—Massive, sessile, covered with nodular tubercles, which are agglomerated into groups. Surface rough, minutely and uniformly granulated. Oscules (and pores?) small, numerous, situated in the sulci between the agglomerated tubercles.

Spicules.—I. Megasclere. 1. *Oxea*, 0·75 by 0·0125 mm.

II. Microsclere. 2. *Aster*, 0·0083 mm. in diameter.

Colour.—When fresh, dull purple-brown. Size, 113 mm. high, 100 and 75 mm. in length and breadth.

Habitat.—South Australia; depth, 3 fathoms.

Coppatias purpureus (Carter).

Stellettinopsis purpurea, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xviii. p. 459, 1886.

Sponge.—Massive, more or less hemispherical. Surface smooth, uneven; pores (?) "punctate, general." Oscules few, large, scattered. Cortex about 0·5 mm. in thickness.

Spicules.—I. Megasclere. 1. *Oxea*, fusiform, curved, sometimes tornote or strongylate at one or both ends, 0·8 by 0·02 mm.

II. Microscleres. 2. *Chiaster*, centrum small, actines numerous, cylindrical, slender, faintly tylote, 0·012 mm. in diameter. 3. *Microxea*, 0·077 by 0·006 mm.

Colour.—Reddish purple. Size, 37 mm. high by 37 mm. in diameter.

Habitat.—Port Western, South Australia.

Coppatias luteus (Carter).

Stellettinopsis lutea, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xviii. p. 459, 1886.

Sponge.—An irregular mass growing over and enclosing fragments of agglomerated sand and shells. Surface smooth. Oscules numerous, large, situated on the summits of low conical elevations, generally distributed. Pores from 0·03 to 0·1 mm. in diameter.

Spicules.—I. Megasclere. 1. *Oxea*, curved, sometimes becoming tornote or strongylate, 0·684 by 0·015 mm.

II. Microsclere. 2. *Chiaster*, centrum small, actines slender, cylindrical, truncate or tylote, 0·018 mm. in diameter.

Colour.—Golden-yellow. Size, 125 mm. in height by 100 mm. in diameter.

Habitat.—Port Western, South Australia.

Coppatias stellifera (Carter).

Amorphina stellifera, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. iii. p. 348, pl. xxix. fig. 10, 1879.

Stellettinopsis stellifera, Ridley, Spong. "Alert," p. 477, 1885.

Sponge.—Massive, lobate, penetrated by a "seaweed" about which it has grown. Pores in sieves (?); oscules in pit-like depressions of the surface.

Spicules.—I. Megasclere. 1. *Oxea*, fusiform, curved, 0·71 by 0·017 mm.

II. Microsclere. 2. *Aster*, centrum absent, actines slender, minutely spined, eight or more in number, 0·017 mm. in diameter.

Size, 50 mm. by 29 mm. by 19 mm.

Habitat.—South Australia; laminarian zone.

Remarks.—Carter assigned this species to *Amorphina* (*Halichondria*); Ridley proposed to transfer it to *Stellettinopsis* (*Coppatias*); but as the oxeas are not arranged in fibrous tracts, the remarks made as to the position of the succeeding species (*Coppatias carteri*) are applicable here. Carter states the sponge only differs from *Halichondria panicea*, Johnst., by the presence of the aster, and if this should prove true of the characters of the canal system, it would directly ally the sponge with *Astropeplus*, since *Halichondria panicea* possesses a eurypylous canal system, scarcely more highly developed than that of *Astropeplus*. In such a case *Halichondria* itself may be regarded as a modified *Astropeplus*, which has in course of phylogenetic development lost its asters.

Coppatias carteri (Ridley).

Stellettinopsis carteri, Ridley, Spong. "Alert," p. 476, 1885.

Sponge.—Massive, lobate, supported on a short cylindrical stalk. Surface verruciform. Oscules not visible.

Spicules.—I. Megasclere. 1. *Oxea*, 1·0 by 0·02 mm.; not collected into fibres.

II. Microsclere. 2. *Euaster*, centrum small, actines cylindrical, strongylate, five to ten in number, minutely spined, 0·05 mm. in diameter.

Colour.—Greyish-white.

Habitat.—Prince of Wales Channel, Torres Strait; depth, 5 to 7 fathoms; bottom, sand and shells.

Remarks.—As according to Ridley the oxeas of this sponge are not collected into distinct fibres, it remains doubtful how far we are correct in assigning it to the genus *Coppatias*. But till the anatomy of the species belonging to this genus has been investigated, the position of all must be regarded as uncertain.

Demus III. Sterrastrosa.

Astrophora in which the characteristic microsclere is a sterraster.

Family I. Geodiidæ.

Sterrastrosa possessing triæne megascleres.

Subfamily 1. Erylina.

The megascleres are orthotriænes and rhabdi; anatriænes and protriænes are absent. The somal microsclere is a diactinose aster (microrabd) or spherule.

Genus 1. *Erylus*, Gray.

The sterraster is seldom spherical; the somal microsclere is a centrotylote microrabd. The incurrent chones are uniporal; and the oscule is the patent opening of a cloaca.

Erylus formosus, Sollas (Pl. XXVIII.).

Erylus formosus, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 195, 1886.

Sponge (Pl. XXVIII. figs. 1, 2).—Of irregular form, tending to grow into lobes and ridges, attached. Oscules round, situated on the top of ridge-shaped growths, or at the end of lobes, few. Pores comparatively large, with slightly everted margins, scattered separately over the surface, not collected into special areas; each is the single distal opening of an incurrent chone. The oscules lead into cloacas wider than themselves; the cloaca is divided below by vertical membranous partitions into large, excurrent canals.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XXVIII. fig. 3), fusiform, usually curved, not sharply pointed, 0·892 by 0·0237 mm.

2. *Orthotriæne* (Pl. XXVIII. fig. 4), rhabdome conical, with slender cladi, curving at first outwards and very slightly forwards, afterwards extending horizontally; both rhabdome and cladi usually bluntly pointed or strongylate. Rhabdome 0·393 by 0·0237 mm., cladi 0·21 mm. in length.

II. Microscleres. 3. *Sterraster* (Pl. XXVIII. figs. 5, 6, 10–12), very various in form, more or less resembling a finger-biscuit, or shuttle-shaped, or lozenge-like; surface granulated with numerous short, cylindrical, or abruptly truncated, conical spines, which are absent over a small central area on one side, corresponding to the hilum of a *Geodia* sterraster; usually about 0·14 by 0·032 to 0·175 by 0·026 mm., sometimes narrower and longer, 0·197 by 0·0236 mm., or shorter and wider, very rarely reaching 0·122 by 0·0474 mm.; the thickness varies from about 0·008 to 0·01 mm.

4. *Somal centrotylote microstrongyle* (Pl. XXVIII. figs. 7, 13), fusiform, smooth, with rounded ends, usually curved, with a central ellipsoidal tylus, 0·07 by 0·006 mm.

5. *Choanosomal oxyaster* (Pl. XXVIII. figs. 8, 9), a few long, slender, cylindrical actines proceeding from a very small centrum, sometimes smooth, sometimes minutely spined near the sharply pointed or abruptly terminated extremities; a single actine 0·0315 mm. long, total diameter 0·063 mm.

6. *Choanosomal chiaster* (Pl. XXVIII. figs. 27, 28), centrum small, actines numerous or not, slender, cylindrical, usually roughened or minutely spined, abruptly truncated, or tylote, 0·012 to 0·016 mm. in diameter.

Colour.—Violet-grey.

Habitat.—Bahia, September 1873; depth, 7 to 20 fathoms.

Remarks.—The single specimen of this sponge, which is nearly but not quite complete, a small portion of the base having been torn away, measures 55 mm. in length, and about 20 to 25 mm. in breadth and height. Of the three oscules present the largest a little exceeds 2 mm. in diameter, the smallest is a little less than 1 mm.

The oscule (Pl. XXVIII. figs. 1, 2) is the slightly constricted external opening of a wider cloaca, which in the case of the largest oscule measures 4 mm. in width. The excurrent canals are traceable through the whole thickness of the sponge.

The pores are closely and generally distributed over the whole surface, a few patches here and there, as is usually the case in the Geodiidæ, being without them. They vary in diameter from about 0·064 to 0·125 mm., and are the very slightly constricted apertures of cylindrical chones, which vary from about 0·08 to 0·2 mm. in diameter (Pl. XXVIII. figs. 14–17).

The cortex (Pl. XXVIII. fig. 17), not more than from 0·2 to 0·25 mm. in thickness, consists chiefly of the sterrastral layer, which is from 0·16 to 0·2 mm. in thickness, the sterrasters lying variously orientated in tangential planes; on the inner face this passes into the usual fibrous layer, here very thin, and on the outer face into

a thin layer of tissue, 0·02 mm. thick, crowded with microstrongyles and covered by the investing epithelium; the outer layer of the cortex is thus barely represented. Throughout the cortex, and particularly on the outer layer, are scattered oval pigment-cells, consisting of a thin cell-wall, enclosing numerous minute, spherical, transparent granules. The cells measure about 0·0158 by 0·0197 mm.; the granules about 0·002 mm. in diameter; their colour in the thin sections appears to be an ochreous-yellow. Ridley, in defining the characters of the genus *Erylus*, remarks that the sterrasters of the cortex are not united by ligaments like those I had described as binding together the sterrasters of other Geodine sponges; but that they lie independently of each other.[1] After a careful examination of the structure of the cortex in this species I offer the following account of the relations of the sterrasters to the accompanying tissue. The latter consists of a finely granular matrix which stains with hæmatoxylin, and contains fusiform cells dispersed through it. Near the innermost fibrous layer of the cortex, fine fibrillæ, no doubt belonging to fibrillated cells like those which bind together the usual Geodine sterrasters, may sometimes be clearly perceived proceeding from the granulated surface of a sterraster, to which they are attached, and extending into the adjacent fibrous tissue. Again, by staining a fragment of the cortex with magenta or hæmatoxylin and teasing out in glycerine, a film of fine fibrillæ may frequently be observed attached at one end to a sterraster, and extending from it into the surrounding medium. That the granulations on the surface of these spicules should serve for purposes of attachment is what one would naturally expect from analogy with the function of the spines of the more usual form of sterraster, especially as like these they do not appear till the last stage in the development of the spicule, when it enters the cortex. On examining thin sections mounted in glycerine one will at first be unable to make out more than granular fusiform cells crossing the sterrasters transversely, but by close observation one may, in many cases, distinguish fine fibrillæ extending from the surface of one of the spicules, and very rarely these can be traced into connection with an adjoining spicule. So rarely, however, does this occur than it can scarcely be regarded as indicating the rule, and I therefore suspect that the fibrillated cells, instead of extending directly from the surface of one spicule to that of another, and for this indeed there is scarcely room, wrap round the surfaces of adjacent spicules and thus bind them together. So far then I can completely confirm Ridley's statement as to the contrast between the structure observable in the cortex of a more typical Geodine sponge and of this; but not as to the independence of the sterrasters; they do not lie loosely aggregated like the orthodragmas in the cortex of *Dragmastra*, but are separately attached to fusiform cells, by which they are united together.

The outer or microstrongylose layer of the cortex is continued down the sides of the chones, as the corresponding layer usually is in the Geodiidæ, forming their walls,

[1] Ridley, Voyage of the "Alert," p. 625.

which vary from about 0·03 to 0·05 mm. in thickness; at the margins of the chones small fusiform cells are accumulated, but do not appear to form a sphinctral ring, nor is any special sphincter to be observed at their inner ends, which open freely into the incurrent canals of the choanosome.

On approaching the oscules the microstrongylose layer is thickened to form the marginal lip (Pl. XXVIII. fig. 15); and the cortex, reduced in thickness and otherwise modified, as by the gradual disappearance of the sterrasters, is continued inwards as the cloacal wall. In a recess of this, just below the oscular margin, the wall presents the structure shown in fig. 18, Pl. XXVIII. It consists of a layer of apparently homogeneous matrix, 0·07 mm. thick, staining with hæmatoxylin, and containing various apparently cellular structures; most exterior are slender threads about 0·02 mm. long, directed at right angles to the outer surface, ending at one extremity against it, and at the other enlarging into a rounded or fusiform body, from which are continued one or two slender thread-like processes deeper into the interior; in some cases these can be traced into connection with somewhat similar but stellate corpuscles which lie in about the middle of the layer; nearer the inner face of this, where it adjoins the sarcenchyma of the choanosome, are similar fusiform bodies lying tangentially. I have spoken of the matrix as only apparently homogeneous, because in some sections it appears to be divided up into oval or rounded polygonal masses about 0·02 mm. in diameter, each enclosing one of the more deeply stained bodies alluded to as a corpuscle; and bounded by pale linear interspaces. It would thus appear that the smaller more darkly stained body is not the whole cell, but only a differentiated part of it. I do not venture to offer an opinion on the significance of these appearances, which appear, however, worth recording.

Choanosome.—The mesoderm is a well-marked sarcenchyma, and, except about the openings of the chones, seldom becomes collenchymatous; the incurrent and excurrent canals are not provided with collenchymatous walls; a sarcenchymatous wall of no great thickness, the sarcencytes of which are usually elongated or fusiform in shape, is, however, sometimes present. Occasionally by a modification of the ectosarc these cells pass into fusiform collencytes. As a consequence of the absence of thick walls, the canal system presents a strikingly open appearance, and velar diaphragms are rare. Scattered through the sarcenchyma are pigment-cells (Pl. XXVIII. fig. 22), which become more numerous in the neighbourhood of the larger canals. They have the same characters as those of the cortex, and are traceable into cells composed of spherical colourless granules which take a deep stain with hæmatoxylin; sometimes one meets with a cell half composed of these protoplasmic granules and half of the pigment-granules into which they become converted. The cells composed of protoplasmic granules are probably derived from deeply staining amœboid cells, possessing a large nucleus and nucleolus, that are found here and there within cavities of the sarcenchyma (Pl. XXVIII. fig. 21). In addition to pigment-cells numerous oval darkly stained bodies of a problematical character are

present (Pl. XXVIII. figs. 23, 24). They measure from about 0·0118 to 0·0434 mm. in diameter, and lie in cavities a little larger than themselves, 0·0197 and 0·0474 mm. in diameter. A concentric or spiral arrangement of interrupted lines is to be observed in them: this in some parts of the section is exchanged for a regularly dotted appearance. In very thin sections, especially in such as happen to be accidentally torn, these appearances are found to be produced by minute bacillar bodies, of which the whole structure is built up. It would appear very doubtful whether these structures are part of the sponge: they might with much more probability be regarded as of a Bacterial nature.

The characters of the canal system have been partly described incidentally; the flagellated chambers are small, about 0·0237 mm. in breadth by 0·0197 mm. in length, the apopyle and prosopyle vary greatly in diameter, from about 0·006 to 0·016 mm., the prosodus is always short, often absent, and the aphodus is usually also short compared to the length it attains in many other *Geodine* sponges.

The Skeleton.—The oxeate spicules are scattered singly and apparently at random through the choanosome, except near the cortex, towards which they are directed at right angles, seldom entering it.

Orthotriænes are absent, except quite close to the cortex (Pl. XXVIII. figs 17, 18) and in the neighbourhood of the cloacal wall, which appears to be a modified cortex. The cladomes of these triænes lie in the inner fibrous layer of the cortex, frequently centrally situated between three or four surrounding chones, so that the cladi extend between adjacent pairs of these latter, often lying tangential to their walls.

The sterrasters are scattered in various stages of development in the choanosome, and when adult are arranged in the cortex in the manner already described. They may be regarded as modifications of the usual more or less spherical sterraster, resulting from the abbreviation of all the actines lying in an equatorial zone including the hilum, and the extension of those lying along and adjacent to the zone-axis. This would be the natural result of tension acting in the direction of the zone-axis.

The youngest sterraster met with resembles that of *Geodia* in presenting a very small centrum and long trichite-like actines; the difference in the length of the actines had already, however, in the instance observed been well established (Pl. XXVIII. fig. 30). This spicule was seen still embedded in its scleroblast, of which, however, the nucleus was not visible. A nucleus, however, was observed of the usual scleroblastic type in connection with a more advanced example, it was situated over that part of the sterraster which remains as the non-granulated area of the completed form (Pl. XXVIII. fig. 31), thus proving the homology of that area with the hilum of the more common form of sterraster. In the stage immediately preceding that of completion the sterraster is smooth, and frequently subdivided at the ends (Pl. XXVIII. fig. 12); the small spines which granulate the surface commence at the extremities and subsequently extend towards the centre.

The microstrongyles occupy the position of a somal aster, *i.e.*, they not only form a layer beneath the epithelium of the cortex (Pl. XVIII. figs. 14, 17), but occur dispersed throughout the choanosome. They are evidently derived from the large oxyaster, or both from a common form like the large aster of *Caminus vulcani*, to the microxea of which the microstrongyles bear a remarkable resemblance. The tension which led to the modification of the sterraster, and the reduction of the oxyaster to a microstrongyle, also manifests itself by sometimes, though very rarely, giving a spiral elongation to the oxyaster, which then reminds one of the plesiaster of some species of *Thenea*.

The chiaster, in some of its varieties indistinguishable from the chiaster of *Myriastra* amongst the Stellettids, first appears in the inner fibrous layer of the cortex, and thence extends through the choanosome, chiefly, if not only, occurring beneath the epithelium of the canal walls. The oxyaster is confined to the choanosome, and though it also occurs along with the microstrongyle and the chiaster immediately beneath the epithelium, its more usual position is somewhat more removed from it, deeper within the sarcenchyma. Numerous transitional forms of aster occur between the chiaster and oxyaster, so that no sharp line of demarcation can be drawn between them.

Genus 2. *Caminus*, O. Schmidt.

The sterraster is spherical, and the somal microsclere a spherule. The roofs of the incurrent chones are cribri-poral; the oscule is the patent opening of a cloaca.

Caminus sphæroconia, Sollas (Pl. XXVII.).

Caminus sphæroconia, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 196, 1886.

Sponge (Pl. XXVII. fig. 1).—Massive, growing upwards into massive, rounded lobes; attached. Oscules situated on the summits of the lobes, large, with wide, smooth margins, leading into a large cloaca, which receives the excurrent canals, opening over its lower half by wide patent mouths.

Pores in sieves, forming the roofs of incurrent chones; the upper surface of the sponge is raised into a polygonal network of low ridges, which mark out the limits of each chone, the polygonal spaces being roofed over by the poriferous membrane. On the lower surface the polygonal outlines are less marked.

The outer layer of the cortex consists of vesicular tissue beneath the epithelium, crowded with but one form of microsclere, the spherule.

Spicules.—I. Megascleres. 1. *Strongyle* (Pl. XXVII. fig. 3), small, cylindrical, straight, curved, or somewhat rapidly bent in the middle, with rounded ends, 0·5 by 0·016 mm.

2. *Orthotriæne* (Pl. XXVII. fig. 4), a conical rhabdome with a strongylate termination, and slender, cylindrical cladi, curving outwards and slightly forwards, with rounded or pointed ends. Rhabdome 0·318 by 0·0158 mm., cladi 0·206 mm. long.

II. Microscleres. 3. *Sterraster* (Pl. XXVII. fig. 5), small, spherical, the ends of the actines granulated, diameter 0·0553 mm.

4. *Somal spherule* (Pl. XXVII. figs. 6–9), a minute sphere with a smooth surface, 0·00395 mm. in diameter. This occurs below the outer epithelium, and is distributed generally throughout the sponge.

Colour.—Somewhat purple on the upper surface, yellowish-white underneath.

Habitat.—Bahia, September 1873; shallow water.

Remarks.—This sponge is represented by a single fine and perfect specimen, with one small, well-marked lobe, and a large, massive part indistinctly divided into two lobes. It measures altogether 130 mm. in length, 100 mm. in breadth, and 80 mm. in height. There are three oscules, one to each lobe; the largest is 11 mm. long by 8 mm. wide, surrounded by a smooth margin, 4 mm. wide. A smaller oscule, 10 by 6 mm., leads into a cloaca, 12 mm. deep and 11 mm. wide in broadest part; it is smooth and imperforate for 6 mm. from the mouth, for the rest of its extent its walls are a mere network, the meshes being occupied by the mouths of the excurrent canals. The excurrent canals extend through the whole length of the lobe in which they occur (Pl. XXVII. fig. 2).

Ectosome.—The cortex (Pl. XXVII. fig. 13) is about 0·796 to 0·92 mm., the ectochrote (Pl. XXVII. fig. 14) from 0·05 to 0·24 mm. in thickness; the sterrastral layer varies but slightly on each side, 0·65 mm. in thickness, and the fibrous layer is from 0·05 to 0·08 mm. thick. On approaching the oscule the cortex is thickened to form its margin and inflected to be continued, somewhat modified, as the lining of the sides of the cloaca. There it becomes somewhat thinner, about 0·636 mm. thick on the average; the ectochrote with its thick crust of spherules is 0·16 mm. thick; the sterrasters are somewhat sparingly scattered through a fibrous tissue 0·238 mm. thick; and the inner fibrous layer without sterrasters is also 0·238 mm. thick.

The pores are chiefly circular, 0·05 to 0·064 mm. wide. They are closely and uniformly distributed over the dermal membrane, not being collected into small circumscribed groups (Pl. XXVII. fig. 11); the very short poral canals unite together immediately below the surface, at first in groups of two forming wider canals; and these are scarcely formed when they similarly coalesce in groups of three and four; the larger canals resulting are separated by walls of vesicular tissue, covered with globules and the all-investing epithelium. The larger canals open freely at the bottom of the ectochrote into the outer end of the chones (Pl. XXVII. figs. 12, 13); the chones are fairly, regularly, and closely distributed, varying from 0·253 to 0·5 mm. in diameter, more or less circular in transverse section, and on the whole more cylindrical than conical in general form.

The vesicular tissue of the ectochrote consists of a collenchymatous matrix which stains with hæmatoxylin, and in addition to the usual collencytes is crowded with empty oval cells, which give to it its vesicular character. These cells are about 0·02 mm. in diameter, and are apparently devoid of contents (Pl. XXVII. fig. 14), except for an oval nucleus 0·005 mm. in diameter, which bulges inwards from the side of the cell-wall. The cell can be traced from this stage backwards to a granular protoplasmic cell, not much larger than 0·005 mm. in diameter, which lies in an oval cavity now a little larger than itself. The cell increases in size; the protoplasm becomes paler in colour, and from surrounding the nucleus as a granular heap, extends from it, by the time it has shifted its position to the side of the cell-wall, in fine, irregular, branching threads, which eventually altogether disappear. The fibres joining the sterrasters are clearly displayed; they represent the fibrillated exterior of fusiform cells. In the associated inner fibrous layer of the cortex densely stained fusiform cells, 0·007 mm. in diameter, are to be met with; in these the protoplasm is granular throughout and exhibits no trace of fibrillation.

Choanosome.—The sarcenchyma of the mesoderm is of the usual character. The flagellated chambers are small, varying from 0·016 to 0·023 mm. in diameter, the aphodus and prosodus alike measure about 0·008 mm. in diameter (Pl. XXVII. fig. 16). The fenestræ of the inner membrane are also very small, about 0·002 mm. in diameter.

Spermatozoa (Pl. XXVII. figs. 18–21).—In certain regions, near the main excurrent canals, the sarcenchyma becomes specially modified to give rise to sperm-clusters. The sarcencytes increase in size and take a more than usually deep stain with reagents, passing into large granular cells, of about 0·02 mm. in diameter, with well-developed nuclei and nucleoli. These next segment and give rise to oval clusters of small spherical cells, with a darkly stained marginal layer and spherical nucleus, separated by an intervening crescentic clear space. Clusters up to about 0·03 mm. in diameter completely fill the cavity which they occupy, but in subsequent stages they are separated from its walls by a considerable interval; thus in a cavity 0·05 mm., a size seldom exceeded, the cluster measures 0·044 mm. in diameter. The sarcencytes which form the wall of the vesicle are extended over its surface and take a somewhat deeper stain than those elsewhere. As the cluster increases, the component cells diminish in size; in a cluster 0·024 mm. in diameter they measure 0·004 mm., in one 0·043 mm. they measure 0·003 mm. in diameter; at the same time the outer marginal layer of each cell becomes thinner and paler. The increase in the number and consequent decrease in the size of the cells appears to take place from without inwards as regards the cluster, so that when the external cells are on the verge of maturity, a comparatively large granular protoplasmic cell may be seen in the centre of the group. Thus in the case of a cluster 0·044 mm. filling a cavity 0·05 mm. in diameter, and composed of cells 0·003 mm. in diameter, an oval granular cell measuring 0·012 by 0·005 mm., and containing an oval nucleus 0·005 by 0·004 mm., persists in the middle of the group (Pl. XXVII. fig. 19); it cannot be regarded

as a cover-cell, at least I imagine not, as the slice in which it occurs is of extreme thinness and the section passes through the very middle of the spermatoblast cluster.

In later stages also one observes spermatoblasts in which the outer wall has been reduced almost to invisibility, forming an outer layer to those less advanced which lie in the interior, and finally one can trace the filaments or tails of nearly mature spermatozoa radiating outwards from the cluster, while the inner spermatoblasts remain in a state corresponding to that of the preceding stage. The nearly mature spermatozoa just mentioned consist of an oval head 0·002 mm. long, with the pale margin still surrounding the nucleus, and a tail which can be measured for 0·012 mm. in length. The excurrent canals in the neighbourhood of the sperm-bearing regions are partly filled with a finely granular stained material which consists of discharged spermatozoa.

Skeleton.—Surrounding the strongyles one observes a thin layer of material of somewhat higher refractive index than that of the sarcenchyma, and in places at irregular intervals this bulges out into oval nuclei, about 0·006 mm. in length, and containing a small spherical nucleolus. The nuclei are flattened against the spicule, and their appearance is suggestive of the existence of a layer of cells surrounding it. It is possible that an irregular film of spongin is associated with the spicules and that the nuclei are those of sponginoblasts.

The strongyles vary considerably in the nature of their terminations, on the one hand pointing towards an oxeate origin, and on the other indicating a tendency to a more pronounced strongylate type. Thus in the average form a slight attenuation occurs as a preliminary to rounding off, and in many cases this becomes so marked that the spicule would be better described as an oxea with a rounded point; in other cases, on the contrary, the strongylation is abrupt and a typical strongyle results. In one or two cases tylostrongyles were observed, the terminal accumulation of silica which we may infer to have converted the oxea into a strongyle having proceeded a step further and rendered the strongyle tylote at one end.

The strongyles are disposed in spicular fibres, which near the cortex are directed towards it at right angles, but away from it they appear to wander without rule, a general tendency to run parallel to the walls of the canals being, however, observable. The orthotriænes appear only at the cortical ends of the fibres, lying with their cladi extended in the fibrous layer of the cortex; hence their rarity in mountings of the separated spicules.

The possibility of the formation of large asters by an overgrowth of small ones is suggested by the occasional occurrence of abnormally large globules (Pl. XXVII. figs. 7–9), which sometimes occur singly, sometimes united together, two or three at a time. These show concentric rings of growth surrounding a central core of substance of the same character as the axial fibre of actinal spicules. The spherules may be frequently observed within the granular cells of the mesodermal sarcenchyma (Pl. XXVII. figs. 16, 22).

The resemblance between this species and *Caminus vulcani*, O. S., is very close, the latter, however, is distinguished by the presence of oxyasters, by the greater length of its oxeate spicules (0·076 by 0·016 mm.), and by the larger size of its sterraster (0·1 mm. in diameter). In other respects the spiculation of both is quite similar, in both the small globules are present, as also are the orthotriænes; these latter I have observed, not only in preparations made by myself from a fragment of the typical sponge preserved in the British Museum, but also in Oscar Schmidt's own slides of mounted spicules presented by him to the British Museum. The asters of *Caminus vulcani* are interesting, as they afford another illustration of the passage from an aster with few actines to an oxeate spicule with a central tylote enlargement; the actines are slender and conical, sharply pointed, and from 0·035 to 0·039 mm. long. The globule is the same size as in *Caminus sphæroconia*; it is frequently produced into a little rounded process on one side, remarkably similar to the rudimentary hypha proceeding from the germinating conidium of a *Penicillium*. It evidently indicates a tendency to return to the astral form from which we must regard it as derived.

Subfamily II. Geodina.

The sterraster is spherical or ellipsoidal; the somal microsclere is a polyactinose aster. In addition to orthotriænes or dichotriænes, protriænes and anatriænes are frequently present.

Genus 5. *Cydonium*, Müller.

The incurrent chones are furnished with cribriporal roofs; the oscules are the uniporal, or more usually cribriporal, openings of excurrent chones which resemble the incurrent chones, but are usually collected in special areas without definite margins.

Cydonium hirsutus, Sollas (Pl. XXI. figs. 30–42).

Cydonium hirsutus, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 197, 1886.

Sponge (Pl. XXI. figs. 30, 31).—Irregular in form, growing into lobes and long, irregular, finger-like processes; bearing in places shallow oval depressions, the floors of which are irregularly pitted, but not perforate. The poriferous roofs of the chones are thickly distributed in some places, absent in others. Surface in places highly hispid, long cylindrical spicules projecting 8 or 9 mm. beyond it; in other places bare. The cortex is thick; below the outer epithelium with its associated minute spherasters is a thin layer of collenchyma, in which the cladomes of the dichotriænes occur, their cladi spreading parallel to the surface, and supporting the poriferous roofs of the chones.

The choanosome presents a cancellous appearance owing to the excessive development of the canals, which form branching vesicular cavities. The large megascleres are irregularly disposed in the choanosome, only assuming a radial direction immediately beneath the cortex.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XXI. fig. 32), fusiform, variously pointed, 4·462 by 0·06 mm. to over 9·0 by 0·0316 mm.

2. *Dichotriæne* (Pl. XXI. fig. 34), rhabdome conical, very thick below the cladome, then rapidly attenuating; cladi bifurcate, protocladi diverging almost horizontally, only very slightly projecting forwards, deuterocladi horizontal. Rhabdome over 4·46 mm. long, by 0·084 mm. broad immediately below the cladome, diminishing to 0·045 mm. in a distance of a little over 0·5 mm.; protocladi 0·127 mm. long, deuterocladi 0·350 mm. long.

3. *Protriæne*, rhabdome long, slender; cladi highly porrectate. Rhabdome 0·02 mm. broad immediately below the cladome, increasing to 0·029 mm. at a distance of about 0·6 mm. from it; cladi 0·127 mm. long, chord 0·143 mm., sagitta 0·099 mm.

4. *Anatriæne*, rhabdome long, slender; cladi short, widely divergent. Rhabdome 0·018 mm. in diameter, cladi 0·036 mm. long.

II. Microscleres. 5. *Sterraster* (Pl. XXI. figs. 35–40), slightly variable in shape, a prolate ellipsoid flattened at the ends of one of the minor axes, tending to a hexagonal or oblong outline; 0·306 by 0·245 by 0·161 mm.

6. *Somal spheraster* (Pl. XXI. fig. 42), minute, an evident centrum produced into several short conical actines, bluntly rounded at the ends; 0·0118 mm. in diameter.

7. *Choanosomal oxyaster*, a scarcely perceptible centrum with a few slender conical actines sharply pointed or with abruptly truncated ends; 0·0197 mm. in diameter, a single actine about 0·008 mm. long.

8. *Cortical spheraster* (Pl. XXI. fig. 41), a comparatively large centrum, produced into several conical oxeate actines, usually minutely and erectly spined; total diameter 0·032 mm., diameter of centrum 0·012 mm.

In my preliminary account I suggested that this microsclere had been introduced as a foreign body from without; I now find that this is certainly not the case; it occupies the usual position of the third aster, when this is present in a Geodine sponge, lying in the innermost fibrous layer of the cortex, and in the choanosome about the subcortical crypts. It also accompanies the megascleres in their passage through the cortex.

Colour.—Greyish-white.

Habitat.—Station 192, Ki Islands, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ W.; depth, 140 fathoms; bottom, blue mud. Trawled.

Remarks.—Neither of the two specimens obtained of this sponge are complete, and it is remotely possible that the missing portions may differ from those that remain by

bearing manifest oscules ; in which case the sponge would, of course, have to be removed from the genus *Cydonium*.

The cortex is 2·5 mm. thick, and is almost entirely constituted by the sterrastral layer. The long spicules of the body pass through it to the exterior, but not in great numbers ; about their distal ends, however, as they pass through the cortex, a considerable number of additional long spicules make their appearance, their proximal ends lying in the outer half or two-thirds of the cortex, their distal ends lying several millimetres beyond its surface. The distal ends are generally broken off, but such as have been observed are simply pointed, so that most of these hispidating spicules are oxeas. Some, however, are modified into tylotoxeas, with large spherical tylotes, which lie embedded in the outer layer of the cortex, the development of the tylotes standing, no doubt, in direct relation to the tensions to which the embedded ends of such long projecting spicules are necessarily exposed. In the case of many Monaxonid sponges the tylote is developed in spicules similarly situated.

The cladomes of the dichotriænes before extrusion from the sponge lie between the outer epithelium and the sterrastral layer, *i.e.*, in the ectochrote, and this is reduced to such thinness that no room is left for any forwardly directed projection of the cladi, hence their extension at right angles to the rhabdome almost immediately on proceeding from their origin. Thus the marked depression of the cladome into a plane at right angles to the rhabdome is to be correlated with the reduction of the ectochrote.

The choanosomal tissue is crowded with a profusion of foreign bodies—skeletons of Radiolaria, of various species of Foraminifera, spicules of Calcareous, Hexactinellid, and Monaxonid sponges, plates of Echinoderms, including the wheel-like scleres of Chirodota, form the bulk of them ; a few grains of sand also occur, and deciduous sterrasters of the sponge itself.

The structure of the sterraster is more than usually well displayed in this sponge. Looked at *en face* the ends of the actines are seen to extend laterally into from four to six recurved spines (Pl. XXI. fig. 37) ; when by a tangential section the spined ends are removed the actines are still seen as separate projecting pillars, but with a circular outline, surrounding an area which is distinguished into a central peripheral portion by a slight difference in refractive index (Pl. XXI. fig. 39). Slightly deeper tangential sections through the solid mass of the spicule reveal the actines as still independent rods, with a circular outline and differentiated central portion, but between them and uniting them into a solid mass is seen a further deposit of silica, which can be distinguished from the actines by a slight difference in refractive index (Pl. XXI. fig. 40). In a longitudinal section the actines are seen as conical rods having their apices at the centre of the spicule and their base outwards. Interstitial silica cements them together almost up to their termination ; where this ceases they extend as separate pillars with concave sides to end in the slightly expanded summit from which the recurved spines proceed (Pl. XXI. fig. 38).

Cydonium magellani, Sollas (Pl. XXI. figs. 1–14).

Cydonium magellani, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 197, 1886.

Sponge (Pl. XXI. fig. 1).—Large, turnip-shaped, or depressed cake-like; attached. Oscules not distinguishable from the pores, both forming the cribriform roof of chones. The spherasters of the outer layer of the cortex all of one kind. The spicules of the radiating sheaves, including oxeas, dichotriænes and anatriænes, pass through the cortex and project beyond it, rendering the surface hispid.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XXI. fig. 2), fusiform, usually curved, bluntly pointed; from 3·927 by 0·0516 mm. to 5·71 by 0·058 mm.

2. *Dichotriæne* (Pl. XXI. figs. 3, 4), rhabdome conical, much attenuated proximally, but rounded off at the end; protocladi projecting outwards and forwards; deuterocladi sometimes horizontal, sometimes projecting forwards as well as outwards. Rhabdome from 3·927 by 0·064 to 4·82 by 0·09 mm., protocladi 0·127, deuterocladi 0·275 mm. long.

3. *Anatriæne* (Pl. XXI. fig. 5), rhabdome cylindrical, rounded off proximally; cladi diverging differently in different varieties, sometimes curving outwards and backwards gradually, and then not markedly stouter near their origin; sometimes rapidly bent backwards after curving more outwards than backwards, and then much thickened near their origin. Rhabdome 7·14 to 7·5 by 0·019 to 0·0237 mm., cladi from 0·11 to 0·16 mm. long, chord from 0·16 to 0·175 mm., sagitta 0·103 to 0·119 mm.

II. Microscleres. 4. *Sterraster* (Pl. XXI. fig. 6), spherical, somewhat depressed; 0·123 by 0·103 mm.

5. *Somal strongylate spheraster* (Pl. XXI. fig. 7), a comparatively large centrum, with numerous short strongylate or abruptly truncate actines; 0·012 mm. in diameter.

6. *Subcortical oxeate spheraster* (similar to that of *Cydonium hirsutus*, Pl. XXI. fig. 41), centrum 0·008 mm. in diameter, produced into conical oxeate actines, sparsely spined; total diameter 0·0217 mm. This is confined to the neighbourhood of the subcortical crypts, occurring chiefly in the innermost fibrous layer of the cortex.

7. *Choanosomal oxyaster.*—In the choanosome the strongylate spheraster (5) passes into an oxeate spheraster (Pl. XXI. fig. 8), and this into an oxyaster 0·016 mm. in diameter.

Colour.—A warm brownish-white.

Habitat.—Station 308, off Tom Bay, Patagonia, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ 0″ W.; depth, 175 fathoms; bottom, blue mud.

Station 311, off Port Churruca, Patagonia, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ 0″ W.; depth, 246 fathoms; bottom, blue mud; bottom temperature, 46°.

Remarks.—Several specimens of this species were trawled. The largest, nearly perfect, is that figured; it measures 90 mm. in height and 100 mm. in diameter; near the summit

it is depressed into an annular valley, which surrounds a small mound-like eminence; the poriferous roofs of chones cover the sides of the sponge up to the outer rounded shoulder which bounds the valley externally; they fail over this, but set in again over the bottom of the depression, and extend all over the central mound except at its very summit, where they are absent. The cortex is about 1·3 to 1·6 mm. in thickness, the thickness of the ectochrote varying from 0·19 to 0·5 mm. This layer (Pl. XXI. fig. 10) consists of numerous cells lying nearly adjacent to each other, but separated by a thin layer of gelatinous matrix, in which they are embedded; in their youngest stage they present themselves as oval or oblong masses of granular protoplasm, which stains deeply, so as almost to conceal the spherical nucleus and nucleolus which it encloses; later the protoplasm begins to disappear, and first at the margins of the cell, leaving very visible an outer cellular membrane, which is quite distinct from the wall of the cavity in the gelatinous matrix within which it lies. In many of the cells of this tissue spherasters may be seen included. The diameter of the cells is about 0·0197 mm., of the nucleus about 0·0039 mm. As this tissue approaches the sterrastral layer the included cells lie somewhat further apart, and present a more regular oval or rounded form; the general appearance of the tissue is that of a gelatinous matrix with oval cells scattered through it. As it approaches the chones it becomes converted into ordinary collenchyma, the collencytes of which radiate more or less towards the chonal walls. The microscleres of this layer are all strongylate spherasters (5).

The sterrastral layer which succeeds is about 1·2 mm. in thickness, and presents the usual structure.

The poral roofs are traversed by fusiform cells. The pores lead into short canals which unite into long, winding, and branching canals, which extend horizontally through the ectochrote. These canals, lined by epithelium which is bulged out by the spherasters underlying it, are crossed by velar diaphragms, and each system which they form is continued into an incurrent chone. The chones are provided with thick muscular sphincters, the myocytes of which are all arranged concentrically (Pl. XXI. fig. 11), surrounding the inner end of the chone. The sphincters lie in the midst of collenchyme, with which they stand in sharp contrast (Pl. XXI. fig. 9). Towards the upper or outer limit of the sphincter, fusiform cells terminate abruptly against the lining epithelium, from which they extend radially into the surrounding myenchyma. These cells measure about 0·02 mm. in length, the nucleus lying about 0·01 mm. from their epithelial ends. Occasionally one may also observe darkly stained stellate cells lying in the myenchyma, near the inner ends of the fusiform cells. It is possible that we have here a rudimentary nervous structure: the fusiform cells may be sensitive, and the stellate cells ganglionic in function. As to the fact of the response of the sphincter to a stimulus directly applied to it there can be little doubt, since by touching or gently rubbing the sphincter of the oscular chones of *Pachymatisma* with the point of a pencil, or any other convenient

style, a slow contraction invariably follows, and this would lead us to expect the presence of such cells, and in such positions, as those here described. The chones open into subcortical crypts, which extend horizontally beneath the cortex, and are continued inwards as the incurrent canals.

The mesoderm of the choanosome is a very distinct sarcenchyma, except where it forms the walls of the larger canals. It then becomes either collenchymatous or fibrous. The flagellated chambers (Pl. XXI. fig. 12) measure from 0·0276 to 0·03 mm. in breadth by 0·02 to 0·0276 mm. in length, the prosopyle is usually about 0·008 mm. in diameter, the apopyle 0·008 to 0·015 mm., the prosodus is usually very short, but in some instances is prolonged to a length of 0·02 mm.

The spicules of the spicular fibres traverse the cortex and extend for all distances up to 1·6 mm. beyond the surface (Pl. XXI. fig. 14); the hispidation thus produced may be regarded as a stage in the process of expulsion of the spicules.

It may be worth while finally to mention the occurrence of an abnormal form of dichotriæne, in which the deuterocladi have themselves become bifurcate, producing tritocladi. This appears to stand in correlation with the fact that the deuterocladi are not always extended tangentially, but point forwards as well as outwards, hence they are liable to bend at some distance from their origin into the tangential position not at first assumed; bending frequently results in branching, and such appears to have been the case in the trichotriæne here recorded.

Cydonium glariosus, Sollas (Pl. XX. figs. 14–21; Pl. XL. figs. 3, 4).

Cydonium glariosus, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 196, 1886.

Sponge (Pl. XX. fig. 14).—More or less spherical, attached. Oscules not distinguishable from the pores, which have the usual sieve-like arrangement. The collenchymatous layer, which lies beneath the external epithelium and its associated chiasters, is crowded with coarse grains of sand, and traversed by radiating pencils of short oxeas; and by the distal ends of the radiating somal megascleres, particularly of the protriænes, the cladomes of which frequently lie within it, but sometimes project beyond the outer surface to the exterior (Pl. XL. fig. 3).

Spicules.—I. Megascleres. 1. *Somal oxea*, fusiform, usually curved, somewhat abruptly pointed, more so at the distal than proximal end; 1·856 by 0·026 mm.

2. *Cortical oxea*, fusiform, abruptly pointed, 0·35 to 0·4 mm. by 0·0158 mm.

3. *Orthotriæne* (Pl. XX. fig. 15), rhabdome conical, attenuated to an excessively sharp point; cladi simple, diverging outwards, at first with a slight forwardly, and afterwards with a slightly backwards directed curve. Rhabdome 2·856 by 0·0516 mm., chord 0·464 mm.

4. *Protriæne* (Pl. XX. fig. 16), rhabdome longer and slenderer than in the preceding,

finely pointed, and at the distal end produced into three cladi projecting chiefly forwards, only slightly outwards. Rhabdome 5·355 by 0·029 mm., cladi 0·08 to 0·11 mm. long, chord 0·095 mm., sagitta 0·064 mm.

5. *Anatriæne* (Pl. XX. figs. 15, 17), rhabdome long, slender, excessively finely pointed, cladi diverging more outwards than backwards. Rhabdome 4·641 by 0·0118 mm., cladi 0·08 mm., sagitta 0·048 mm., chord 0·125 mm. in length.

II. Microscleres. 6. *Sterraster* (Pl. XX. fig. 18), spherical, 0·0516 to 0·058 mm. in diameter.

7. *Somal chiaster*, centrum small, actines cylindrical, rod-like, strongylate or truncate, seldom conical and pointed; total diameter 0·01 mm. These microscleres form a layer beneath the outer epithelium, and are generally scattered through the sponge.

8. *Choanosomal oxyaster* (Pl. XX. fig. 19), centrum small; actines slender, conical, pointed, or rod-like, abruptly truncated; a single actine measures about 0·008 mm. in length, number of actines variable, usually from six to eight; total diameter from 0·016 to 0·0193 mm.

9. *Subcortical spheraster* (Pl. XX. fig. 20), centrum comparatively large, half the diameter of the spicule, actines cylindrical, truncate; total diameter 0·016 mm. These microscleres are confined to the inner fibrous layer of the cortex and its neighbourhood.

Colour.—Yellowish or brownish white.

Habitat.—Off Bahia, September 1873; depth, 7 to 25 fathoms.

Remarks.—This sponge, of which two specimens, each about 25 mm. in diameter, were obtained, is distinguished by the unique character of its cortex; no other Geodine sponge, so far as is known, incorporates foreign bodies within its substance. The nearest related Tetractinellid in which a similar feature occurs is the Stellettid *Psammastra murrayi*, in which the sand-grains are found not only in the outer but in the inner fibrous portion of the cortex; in *Cydonium glariosus* they are excluded from this layer by the presence of the sterrasters, which leave no room for them. It is of course a common occurrence amongst the Stellettids, as well as other Tetractinellids, for the sponge to attach foreign material to the exterior of the cortex, often by means of fibrous strands, but there as a rule the process stops: in *Cydonium glariosus* the grains of sand occupy the place which in *Cydonium eosaster* is taken by spherasters.

The sand-grains appear to be introduced into the cortex immediately from without and not from the choanosome, since foreign bodies are only very exceptionally present in it, much less frequently than is often the case in other sponges; and even if they were more largely present it would be difficult to understand how they could make their way through the sterrastral layer to the exterior. But for these serious objections one might have regarded the sand-grains as an accummulation of extruded foreign particles, which were first carried in by the water circulation to the canal system (as so often happens

in other cases), and which thence made their way into the choanosome and so to the exterior.

The cortex (Pl. XL. fig. 3) measures about 0·79 mm. in thickness, the ectochrotal layer containing the sand-grains is about 0·4 to 0·45 mm. thick, the sand-grains are angular or subangular and irregular in shape, varying considerably in size from about 0·16 to 0·4 mm. in length. The pencils of radiating cortical oxeas (No. 2) pass between adjacent sand-grains, several pencils surrounding each individual grain as though keeping it in place. The layer of sterrasters is sharply defined from the preceding, and measures about 0·24 mm. in thickness. The usual fibrous layer, about 0·0475 mm. thick, completes the cortex on the inner side. The somal megascleres have the usual arrangement in radiating sheaves, but they are frequently crossed by small scattered oxeas, similar to those of the cortex. The pores (Pl. XL. fig. 4) present the usual characters, and vary from about 0·025 to 0·05 mm. in diameter, a large oval pore often measuring 0·067 by 0·028 mm. The canal system is more open than in *Cydonium eosaster*, the mesodermal sarcenchyma not having encroached so far upon the lumen of the canal, hence the aphodi are usually short, and indeed occasionally absent, the chambers then becoming eurypylous. The chambers are small, about 0·02 mm. in diameter on an average.

Cydonium eosaster, n. sp. (Pl. XX. fig. 22 ; Pl. XXI. figs. 15–29).

Sponge (Pl. XXI. fig. 15).—Spherical, free, oscules not distinguishable from the pores which occur in sieves overlying the chones ; surface smooth, even, with a few small, rounded, solid warts or tubercles ; cortex thin, the minute spherasters which underlie the outer epithelium are succeeded by a layer of larger spherasters of different form (Pl. XXI. fig. 23) ; the rest of the cortex is formed by the sterrastral layer.

Spicules.—I. Megascleres. 1. *Somal oxea* (Pl. XXI. fig. 16), fusiform, usually sharply pointed ; 2·856 by 0·032 mm.

2. *Cortical oxea*, 0·25 to 0·3 by 0·0035 mm.

3. *Dichotriæne* (Pl. XXI. fig. 17), rhabdome conical, much attenuated proximally to a very sharp point, or rounded off near the end ; protocladi projecting outwards and only slightly forwards, deuterocladi directed outwards and slightly backwards. Rhabdome 3·57 by 0·047 mm., protocladi about 0·11, deuterocladi about 0·21 mm. long.

4. *Protriæne* (Pl. XXI. fig. 20), rhabdome slender, tapering towards the cladome ; cladi directed forwards and only slightly outwards. Rhabdome 5·0 by 0·026 mm. when widest, 0·019 below the cladal origin ; cladi 0·19 mm. long, chord 0·19 mm.

5. *Anatriæne* (Pl. XXI. figs. 18, 19), rhabdome long, slender, conical, attenuated proximally, either very sharply pointed, or strongylate ; cladi extending chiefly outwards, very slightly backwards. Rhabdome 8·21 by 0·029 mm., cladi 0·095 mm. long, chord 0·19 mm., sagitta 0·048 mm.

II. Microscleres. 6. *Sterraster* (Pl. XXI. fig. 21), spherical, depressed, 0·064 to 0·07 mm. in diameter.

7. *Somal spheraster* (Pl. XXI. figs. 22, 23), a large spherical centrum produced into numerous short obtusely conical spines; usually 0·0198 mm. in diameter, sometimes as much as 0·031 mm.; the spines of forms larger than the average are often expanded at the end, and much resemble the spines of a sterraster.

8. *Somal spheraster* (Pl. XXI. fig. 24), minute, of very variable characters, usually a well-marked centrum, with thick conical or rod-like actines, abruptly truncated at the ends or strongylate; the actines may increase in length and become sharply pointed, or they may be reduced till the aster passes into a mere globule. Diameter 0·01 mm.

9. *Choanosomal oxyaster* (Pl. XXI. figs. 25, 26), a small centrum, and smooth, slender, sharp, conical actines; usually numerous, sometimes reduced to four or five; usually about 0·012 mm. long, sometimes as much as 0·017 mm.; total diameter from 0·0276 to 0·039 mm.

Colour.—Yellowish-white.

Habitat.—Port Jackson, June 1874; 6 to 15 fathoms.

Remarks.—There are two specimens of this sponge, the largest 22 mm. in diameter. The cortex (Pl. XXI. fig. 29) is about 0·318 mm. thick. Externally it is invested by an epithelial layer, beneath which lie the minute spherasters (No. 8); a single layer of spherasters (No. 7) embedded in collenchyma succeeds; then follow the sterrasters; the innermost layer of the cortex is very thin, and consists chiefly of fibrous tissue, the cladomes of the dichotriænes lie within it, and in the areas between the cladi the endochones are situated. The chones are of the usual character, the pores of their roofs are about 0·016 to 0·05 mm. in diameter, or on an average 0·025 mm.; the sphincter dividing the ectochone from the endochone is well developed. The chones lead into incurrent canals which descend radially into the choanosome, several uniting some distance below the cortex into a large canal running concentrically (Pl. XXI. figs. 27, 28). The relations of the smaller branches of the incurrent and excurrent canals to one another and the flagellated chambers is shown in thin sections with diagrammatic clearness (Pl. XX. fig. 22), and the incurrent system can be traced from beginning to end; the excurrent canals have, however, only been traced in one direction, *i.e.*, towards the flagellated chambers; whenever an excurrent canal is traced towards the cortex it is found to end by branching into flagellated chambers, and in no case has it been traced into connection with a chone; only one-half of the small specimen was cut up into serial slices, and it is possible, therefore, that the excurrent chones will be found in the remaining half.

The flagellated chambers measure about 0·0276 mm. in length by 0·0316 mm. in breadth; they lie immediately adjoining the sides of the ultimate branches of the incurrent canals, with which they communicate by prosodi, about 0·012 mm. in diameter,

and so short that they may more properly be regarded as prosopyles; their communication with the excurrent canals is by means of aphodi, which are about 0·012 mm. in diameter where they enter the chamber. Their length is variable, standing in adaptation to the distance of the chambers from the excurrent canal; they are either simple or unite together branch-like as they approach their termination.

The choanocytes are preserved chiefly in an extended state; they measure about 0·014 mm. in length.

The species most nearly related to this appears to be *Cydonium globostellata*, Carter, which is distinguished by the substitution of orthotriænes for dichotriænes, and these are smaller than the dichotriænes of *Cydonium eosaster*.

Genus 6. *Synops*, Vosmaer.

Poriferous and oscular surfaces of the sponge distinct. Oscules the single openings of excurrent chones; pores in sieves overlying incurrent chones.

Synops neptuni, Sollas (Pls. XXIV.–XXVI.).

Synops neptuni, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 198, 1886.

Sponge (Pls. XXIV., XXV.; Pl. XXVI. fig. 1).—Cup-shaped; walls thick, diminishing to a narrow edge at the summit, attached, sessile. Both inner and outer surfaces deeply corrugated, on the outer surface the sinuses of the corrugations continued into the thickness of the walls as irregular canals. Surface smooth. Oscules scattered over the interior of the cup, pores on the outside. Cortex moderately thick, constituted chiefly by sterrasters; beneath the epithelium a layer of minute chiasters.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XXVI. figs. 2, 3), fusiform, straight or curved or sinuous, bluntly or sharply pointed, or rounded off at the ends, 1·27 by 0·0193 mm.

2. *Orthotriæne* (Pl. XXVI. fig. 4), rhabdome conical, tapering to a filiform, sharply pointed extremity; cladi curving outwards and but slightly forwards, ends usually rounded off or bluntly pointed. Rhabdome 0·964 by 0·016 mm., cladi 0·18 mm. long, chord 0·355.

3. *Anatriæne;* but a single specimen seen; cladi short, 0·019 mm. long; rhabdome broken, over 0·26 mm. long by 0·011 mm. in diameter.

II. Microscleres. 4. *Sterraster* (Pl. XXVI. figs. 5, 8), spherical, ends of actines small, polygonal, bearing five or six recurved spines, 0·448 in diameter.

5. *Somal chiaster* (Pl. XXVI. fig. 10), centrum scarcely distinguishable, several short, abruptly truncated, rod-like actines; total diameter when occurring in the cortex 0·006 mm.; in the choanosome 0·008 mm.

6. *Subcortical spheraster*, an evident centrum and numerous rod-like actines, 0·016 mm. in diametor.

7. *Choanosomal chiaster* (Pl. XXVI. fig. 9), no visible centrum, somewhat, but not very numerous, slender, hair-like or rod-like actines, from 0·0118 to 0·016 mm. long; total diameter 0·024 to 0·0276 mm.

Colour.—In the dried state nut-brown.

Habitat.—Station 122B, off Brazil, September 10, 1873; lat. 9° 9′ S., long. 34° 53′ W.; depth, 32 fathoms; bottom, red mud. Trawled.

Remarks.—The species is represented by a single specimen, the largest Tetractinellid sponge known. The cup stands on a rounded base about 12 cm. in diameter, and rises to a height of 40 cm. At its broadest part its diameters are 22 and 31 cm. The interior conical or funnel-shaped cavity commences about 12 to 13 cm. from the base. In the illustration it is represented as extending completely through the basal part of the sponge; this is the result of an injury, or to the sponge having grown over some stake-like support which has since been torn away. The actual extent of the true internal cavity is indicated in the figure (Pl. XXV.) by the broad white line which represents the cortical layer of the interior; this will be observed to suddenly cease at the point where the basal perforation begins. The diameters of the cup at its margin are 21 and 15 cm. Thin at the margin, the walls increase in thickness downwards, and 12 to 13 cm. from the summit they measure 45 mm. where thinnest and 85 mm. where thickest. Both inner and outer surfaces are much folded, growing out into irregular, sinuous, branching, anastomosing ridges, diversified by lobes and tubercles. On the outer surface the ridges in their upward growth frequently terminate in lobate summits; and the irregular grooves between them are frequently circumscribed, forming pits, which descend deeply into the thickness of the sponge-wall, as sinuous cavities. The mouths of these canals are shown in Pl. XXIV. The upper half of the interior surface (Pl. XXV.) is folded into sinuous, more or less longitudinal, ridges, which as they descend become confluent in an irregularly undulating surface. Looking at the margin of the cup, face on, it is seen to be irregularly plicated or "goffered." The margin may be regarded as the latest formed part of the sponge, and from its manner of growth we obtain a key to the complications of the older and indeed aged part of the sponge-wall. Let us assume that at an early stage the young sponge acquired a cup-like form. The mode of growth of the margin was similar to that of the existing margin; *i.e.*, the growth of the surface proceeded more rapidly than that of the interior of the wall, and folding of the margin was the result (Fig. 2, *a*). The pleats once formed continued to grow in the same manner, *i.e.*, the superficial growth was more rapid than the deep-seated, and secondary and tertiary pleats arose upon those first formed (Fig. 2, *b*, *c*), more particularly on those of the exterior of the sponge-wall. It is well known that concrescence frequently results when two growing surfaces

of the same sponge, or even different individuals of the same species of sponge, are brought in contact, and thus we may conclude that the pleats wherever they touched each other coalesced; in this manner a complex folded sponge-wall, traversed by sinuses, and much thicker than of the earlier stage, would result (Fig. 2, *d*). Obviously this wall may by a continuation of the same process increase in thickness and complexity to an almost unlimited extent. A transverse section (Pl. XXVI. fig. 1) through the actual sponge presents appearances which are entirely consistent with the foregoing explanation. The diagram (Fig. 2, *d*) might well stand for a generalised representation of its structure; there are sinuous passages of the most irregular form, some still merely deep extensions of the outer folds, others converted into complete canals opening by circular mouths to the interior; some communicating with the inner surface of the cup, but more with the outer. All are lined by a thin layer of sterrasters, thus demonstrating their superficial origin, and proving that they are in no way connected with the true water-canals of the sponge.

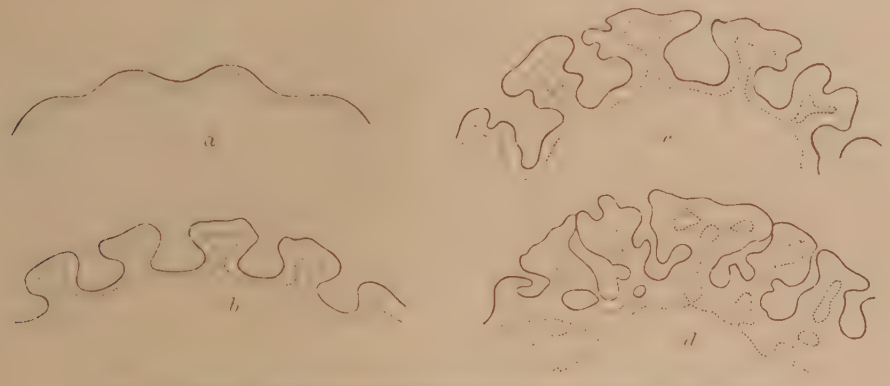


FIG. 2.—Diagram showing the development of the wall of *Synopsis neptuni*, Sollas.

The passages are seldom empty, usually they are closely packed with a substance which looks like cotton wool, but which really consists of sponge spicules densely matted together, every one of them identical in character with those which build up the skeleton of the sponge. They are deciduous spicules, which have been secreted by the sponge and shed from its free surface; and they owe their preservation in these cavities to the accident that a part of the free surface has here become involved in the interior of the wall. In most sponges the effete spicules when they are shed from the sponge fall to the sea-floor and dissolve all connection with their source. Here, owing to fortunate circumstances, they are preserved to suggest the existence of a process which might otherwise have been overlooked. Whilst there are other sponges which also furnish evidence as to the deciduous nature of the spicules, there are none which would have led us to suppose that the quantity of deciduous material is so large as from this sponge we learn to be the case, for the quantity of dead spicules accumulated within its

cavities stands in no insignificant ratio to the mass of its skeleton. In the figures (Pl. XXV.; Pl. XXVI. fig. 1) some of the cavities still filled with spicules are indicated, but many of those represented as empty were filled when the sponge was cut open, and afterwards cleared out to better understand the nature of the cavity. In a paper dealing with the formation of flints, I suggested (while ignorant of the deciduous nature of sponge spicules) the following analogy:[1]—

"Excepting that sponges do not periodically shed their spicules like leaves and spores, the explanation we have just suggested bears a striking resemblance to the 'growth in place' theory of our coal beds. In the coal, as in the flints, the structure of the constituents has generally been almost entirely obliterated, yet some few of the leaves or spicules, as the case may be, are occasionally found in an admirable state of preservation; and just as a *Sigillaria* every now and again remains a solitary survivor of a whole forest, so now and then a whole sponge is to be found preserved out of a host of associates now vanished or turned into flint."

It would now seem (leaving out the word "periodically") that the exception with which I guarded this analogy disappears, and the source of the silica of flints becomes less perplexing. At the quiet bottom of a chalk sea the spicules as they were shed would remain strewn around the parent sponge, and undergoing solution from the moment they were liberated, would commence the transformation of chalk into flint *pari passu* with the life of the sponge.

The cortex of the sponge is about 0·8 mm. thick (Pl. XXVI. figs. 11–13). It consists almost entirely of the sterrastral layer, covered externally by a layer of subepithelial chiasters. Small oxeas project from its outer surface in the neighbourhood of the pores, and the cladomes of the orthotriænes extend within the inner fibrous layer. The oscules are from 0·08 to 2·0 mm. in diameter. Although the sponge is a dried specimen, sections were cut from it in the usual way; the cribriform roof of the poral chones and the sphincters of the oscules were thus demonstrated (Pl. XXVI. figs. 11–13); it is a remarkable fact that the fibrous structure of the tissue binding together the sterrasters of the cortex and the fibrous structure of the inner layer of the cortex are still preserved; and not only so, but the fibres of the muscular sphincters, characteristically different from those of the inner cortex, and sometimes possessing a well-preserved nucleus, are distinguishable. Even indications of flagellated chambers are occasionally to be made out in the choanosome, and a vesicular character in the collenchyma, which occurs in the neighbourhood of the cortical layer of the sinuses of the wall. This latter layer is very thin, the sterrasters are accumulated to form a stratum 0·16 mm. thick, and beneath this follows a somewhat close accumulation of oxeate spicules, lying chiefly parallel with the surface, many with much enlarged canals. It appears as though these were dead spicules, on the way to be thrust out to the exterior.

[1] Sollas, On the Flint Nodules of the Trimmingham Chalk, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vi. p. 443, 1880.

Synops nitida, Sollas (Pl. XXII.).

Synops nitida, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 198, 1886.

Sponge (Pl. XXII. figs. 1, 2).—Plate-like, thicker in the middle, thinner towards the margin. Oscules numerous, restricted to the upper surface, over which they are dispersed; each oscule is the simple mouth of an excurrent chone. Pores numerous, in sieve-like areas, forming the roofs of incurrent chones, restricted to the lower surface, over which they are closely scattered. Each sieve-like area contains but few pores, usually from two to four, sometimes more, sometimes only one. Upper surface smooth and shining, alabaster-like, partly even, partly irregularly depressed and elevated; lower surface smooth, dimpled, rising into irregular rounded swellings, rounded at the margin when it passes into the upper surface. On both upper and lower surfaces are openings which lead into cavities extending into the middle of the sponge; these cavities are lined by a thin layer of sterrasters, continued from the sterrastral layer of the cortex. Beneath the outer epithelium is a layer of small spherasters; these are immediately succeeded by the sterrastral layer, which constitutes almost the whole of the cortex. It maintains the same thickness on the oscular as on the porous face of the sponge.

Spicules.—I. Megascleres. 1. *Oxea* (Pl. XXII. fig. 3), fusiform, rapidly curved near the middle, variously pointed, seldom sharply; 1·25 by 0·026 mm.

2. *Orthotriæne* (Pl. XXII. fig. 4), rhabdome somewhat short, conical, not sharply pointed; cladi conical, frequently recurved close to the obtuse points, projecting outwards, and only slightly forwards. Rhabdome 1·07 by 0·0387 mm., cladi 0·183 mm. long, chord 0·358 mm. sagitta 0·05 mm.

II. Microscleres. 3. *Sterraster* (Pl. XXII. figs. 5, 8), spherical, small, 0·0516 mm. in diameter.

4. *Somal spheraster* (Pl. XXII. figs. 7, 12), a comparatively large centrum; short, thick actines, with rounded ends; 0·0135 mm. in diameter.

5. *Choanosomal oxyaster* (Pl. XXII. figs. 6, 9–11), a small centrum, and long, conical, erectly spined actines, usually few, about seven, sometimes numerous; length of a single actine 0·0197; total diameter 0·0434 mm.

Colour.—A faint brownish-white.

Habitat.—Port Jackson, Sydney, January 3, 1874; depth, 30 to 35 fathoms.

Remarks.—The single specimen obtained of this sponge is not quite complete, one edge being broken; it measures 130 mm. in length, in which direction it appears to be complete, 41 mm. in breadth (it was broader when perfect), and 26 mm. in maximum thickness. The smooth and shining appearance of its almost white oscular surface strikes the eye at once, and is more obvious in the specimen than the illustration. The oscules are small, none much over 0·5 mm. in diameter, and many much less; the open mouth

of a large oscule appears as a dark circle surrounded by an annulus,—the slightly everted margin, which by its snow-whiteness stands in contrast with the slightly brownish tint of the general surface; the smallest oscules are indicated by a white dot, the wall and not the lumen of the oscular tube being alone visible. The appearance given by these white dots and circles to the oscular surface is very characteristic. The pores, 0·03 to 0·1 mm. in diameter, occur in sieves (Pl. XXII. fig. 14) overlying chones, which, like the oscular chones, are provided with thick walls of fibrous collenchyma, in which are frequently dispersed small oval vesicular cells, ·0·015 mm. in diameter, containing numerous deeply stained, minute, spherical granules. Similar cells are scattered through the collenchyma and adjacent sarcenchyma of the choanosome, chiefly when it surrounds the larger canals. The thickness of the collenchymatous wall and the diameter of the lumen of the chone are highly variable, and stand in no constant relation to one another (Pl. XXII. figs. 15–18). Thus in the case of the poral chones we have the following measurements:—In one case, diameter of the lumen 0·019 mm., diameter of the entire chone from sterraster to sterraster 0·193 mm.; in another, diameter of the lumen 0·129 mm., of the chone 0·193 mm.; and in a third, diameter of the lumen 0·039 mm., and of the chone 0·039 mm., or practically no distinct wall at all. This variation does not depend on the state of contraction of the fibrous collenchyma, either it is accidental or due to age or some other unknown cause. About the pores, on the one hand, and the inner termination of the chone on the other, the fibrous collenchyma passes into true myenchyma, the myocytes of which are arranged concentrically, sphincter-like.

The pore-sieves are more richly scattered over some portions of the porous surface than others. The margins of the sieves are surrounded by the sterrasters of the cortex, the margins of the pores by the spherasters of its outermost layer. This at least is the appearance presented by a slice taken tangentially; as a matter of course the spherastral layer extends over the whole exterior of the sponge, but the sterrasters do not extend into the poral roof, or do so only occasionally.

The poral chones lead into incurrent canals, which, like the excurrent canals, are provided with collenchymatous walls of very variable thickness; both sets of canals are frequently crossed by velar diaphragms which convert them in many cases into a succession of vesicles. Sometimes in the same collenchymatous tract a double row of vesicles may be seen running side by side, and communicating laterally at intervals, the result apparently of the conversion of an originally single canal into two by an excessive development of collenchyma.

The incurrent canals sometimes descend directly from the chone radially into the sponge, sometimes they first extend tangentially to the inner surface of the cortex.

The oscular chones are similar to the poral but larger, and without the sieve-like roof (Pl. XXII. fig. 13). They vary in size considerably; a somewhat small example measured 0·478 mm. in diameter, and the lumen 0·318 mm. in diameter, the walls in this instance

being 0·08 mm. thick. Large excurrent canals proceed from them, and approaching the poral surface their branches run radially towards it, interdigitating with the incurrent canals. The flagellated chambers are usually nearly spherical, the largest measuring 0·0276 mm. in diameter, the prosopyle from 0·008 to 0·01 mm., and the apopyle from 0·008 to 0·012 mm. in diameter. The aphodal canals are frequently constricted into a series of vesicles by extension inwards of their walls, after the manner of velar diaphragms.

The secondary canals formed by an extension inwards of the oscular and poral surfaces do not appear to bear chones in their walls, at least not in the case of those produced from the latter surface. The others cannot be examined without injury to the specimen. Fragments removed from the invaginated poral surface show first a chitinous layer produced by some species of Hydrozoon which infests them, and beneath this a thin layer representing a modified cortex; it consists of sterrasters, two or three deep, coated by a single layer of the ectochrotal spherasters; but neither in tangential fragments torn away, nor in transverse sections, was a vestige of a chone or any other poral aperture to be found. These canals cannot, therefore, be regarded as vestibular. The chitinous layer which loosely lines the canals contains numerous deciduous spicules, which have been extruded from the sponge; the modified cortex is also hispidated, though no trace of hispidation can be distinguished on the outer surface, not even in thin slices when subject to microscopic examination.

The cortex (Pl. XXII. fig. 13) is about 0·478 mm. in thickness, almost entirely constituted by the sterrastral layer, the ectochrote being represented merely by the thin layer of tissue in which the single layer of somal spherasters occurs. The innermost fibrous layer of the cortex is also excessively thin; the cladomes of the orthotriænes lie in this, apposed to the overlying sterrasters. They seldom extend into the sterrastral layer.

The choanosome is sarcenchymatous, except where it forms the collenchymatous walls of the canals. It is infested, especially when it becomes collenchymatous, by a species of *Oscillaria*, of much smaller dimensions than that described from some of the Australian Stellettids. The thickness of the filaments is 0·00395 mm., or very slightly less; in length I have measured them up to 0·138 mm.; the length of each joint would appear to be about 0·0022 mm.

The megascleres are arranged partly in bundles or spicular tracts accompanied by fusiform cells, partly scattered singly through the choanosome; they show very little constancy in direction; some of the fibres run parallel to the walls of the larger excurrent canals, others, and these are more numerous, quite irregularly; but on approaching the cortex the spicular fibres are always directed at right angles to it, and the orthotriænes first appear in its immediate neighbourhood.

The sterrasters present an appearance of coarseness, owing to the fact that, notwithstanding their small size, their component actines have nearly the same diameter as

those of larger forms, *e.g.*, the sterrasters of *Cydonium hirsutus*. The ends of the actines are not produced into spines, but rounded and covered with granulations.

Synops vosmaeri, Sollas (Pl. XXIII.).

Synops vosmaeri, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 197, 1886.

Sponge (Pl. XXIII. fig. 1).—Cylindrical, with a cup-shaped depression, surrounded by a rounded margin, at the upper end; erect, attached. Oscules confined to the cup-shaped depression, the patent openings of excurrent chones. Pores in sieves (Pl. XXIII. fig. 17), collected into oval depressed areas on the lateral surface, which is raised into irregular rounded ridges running chiefly longitudinally, the depressions bearing the pores lying between. Some of the depressions are continued as tubes into the middle of the sponge-body, their walls being lined by an extension of the cortex, much reduced in thickness, and bearing numerous pore-sieves. Cortex; the ectochrote is crowded with spherasters of the same kind as those associated with the epithelium; the sterrastral layer is thin and the fibrous layer underlying it remarkably thick.

Spicules.—I. Megascleres. 1. *Somal oxea* (Pl. XXIII. figs. 3, 4, 12), fusiform, sharply pointed or not, straight or curved, from 1·321 by 0·016 to 1·68 by 0·008 mm.

2. *Cortical oxea* (Pl. XXIII. figs. 6, 14), slender, fusiform, 0·3 by 0·004 mm.

3. *Orthotriæne* (Pl. XXIII. fig. 5), rhabdome conical, usually sharply pointed; cladi simple, diverging outwards, at first slightly forwards, and subsequently backwards. Rhabdome 1·107 by 0·0387 mm., cladi 0·286 mm. long.

II. Microscleres. 4. *Sterraster* (Pl. XXIII. figs. 7, 9), small, spherical, ends of the actines slightly smaller than those of the corresponding spicule of *Synops nitidus*, not so closely contiguous, and with fewer spinelets; 0·0394 mm. in diameter.

5. *Somal spheraster* (Pl. XXIII. fig. 11), minute, a somewhat small centrum; short, relatively thick, minute actines, truncate or rounded at the ends; 0·004 mm. in diameter.

6. *Choanosomal oxyaster* (Pl. XXIII. figs. 8, 10), a scarcely perceptible centrum, long, slender, hair-like actines, not numerous, usually six to ten in number; length of a single actine 0·0118; total diameter 0·0256 mm. In the neighbourhood of the subcortical canals this form becomes somewhat modified, the actines are shorter and more numerous, and a small but evident centrum is present; the diameter of the variety is about 0·016 mm.

Colour.—Cream-white, stained pink in places by a rhodophycaceous *Alga*.

Habitat.—Station 122, off Barra Grande, September 10, 1873; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud. Trawled.

Remarks.—The single specimen of this sponge is fairly symmetrical in shape, and perfect from base to summit; it measures 96 mm. in height and 50 mm. in diameter. The margin of the cup at the summit is thicker and higher on one side than the other.

The false incurrent canals formed by invaginations of the cortical layer are some of them lined by a chitinous layer produced by a species of Hydroid; one contains an Ophiurid, its disc lying about 15 mm. from the exterior, with one arm extending from it along the false canal, protruded at the exterior.

The false canals are apparently of the same nature as the cavities described by von Lendenfeld as vestibules, and they may therefore be appropriately named vestibular canals.

The large excurrent canals run chiefly longitudinally, and are traceable from the base to the oscular chones.

The cortex (Pl. XXIII. fig. 15) of the oscular surface is about 0·637 mm. thick, and composed as follows:—An outer epithelium covering the ectochrote, which is crowded with minute spherasters (5); this, which is very thin (0·01 to 0·04 mm.), is succeeded by the sterrastral layer, 0·143 mm. thick, including the ectochrote; then follows a dense felt of deeply staining fibres 0·334 mm. thick, and finally a fibrous collenchymatous layer 0·16 mm. thick. Immediately about the oscules the total thickness of the cortex is increased to about 0·828 mm. On the poriferous surface (Pl. XXIII. fig. 16) the cortex is thicker, about 1·33 mm. on an average; it is made up as follows:—First, the ectochrote 0·0318 mm. thick, then the sterrastral layer 0·191 mm. thick, and, finally, the fibrous layer 1·114 mm. thick.

About the margins of the oscules and the roofs of the poral chones the small oxeas (No. 2) appear within the outer half of the cortex; and, projecting slightly from the surface, give it a slightly pilose appearance.

The spicules of the body do not run radiately to the cortex; only those immediately next the cortex are directed at right angles to it; the majority run in spicular fibres, (accompanied by numerous fusiform cells and collenchyma) in various and apparently irregular directions through the choanosome. Near the oscular surface many of these fibres run transversely to the excurrent canals, and subdivide the choanosome, containing flagellated chambers, into curiously restricted areas. The sterrastral spicules are the smallest I have yet seen, possibly the smallest known. By this character the sponge may be at once distinguished from *Synops pyriformis*, Vosmaer. The spines of the actines are few and small, but they still serve for the attachment of the connecting fibres. On the oscular surface the sterrasters form a layer only two or three thick. The orthotriænes lie with their cladomes immediately below the fibrous layer of the cortex, occasionally extending into it.

The roofs of the poriferous chones lie in depressions below the general surface of the poriferous area, and the sterrastral layer curves downwards towards the chones as it approaches them. The chone traverses the greater part of the fibrous layer before it becomes constricted by the sphincter.

The flagellated chambers vary from about 0·0237 by 0·0276 to 0·0276 by 0·0315 mm. in diameter.

Genus 7. *Isops*, Sollas.

Oscules and pores similar, both the simple apertures of similar chones.

Isops pachydermata, Sollas.

Isops pachydermata, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 198, 1886.

Sponge.—An irregular rounded mass; attached. Surface smooth, raised at intervals of about 7 mm. into small rounded bosses or tubercles, each perforated centrally by a single aperture, the distal mouth of a chone. Oscules and pores similar, each the simple mouth of a chone. Cortex thick, constituted almost entirely by the sterrastral layer; beneath the epithelium a layer of spheraster.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, straight or more usually curved, bluntly pointed or strongylate; 1·96 by 0·04 mm.

2. *Orthotriæne*, rhabdome conical, strongylate; cladi, conical, straight, projecting outwards and slightly forwards. Rhabdome 1·07 by 0·0387 mm., cladi 0·27 mm. long.

II. Microscleres. 3. *Sterraster*, more or less ellipsoidal, compressed, actines bearing from four to six small recurved spines; 0·24 by 0·187 mm. in diameter.

4. *Somal spheraster*, minute, a comparatively large centrum, bearing numerous short, cylindrical, abruptly truncate actines. Centrum 0·008 mm. in diameter, actines about 0·003 mm. in length, total diameter 0·014 mm.

5. *Choanosomal oxyaster;* no differentiated centrum, actines long, slender, conical, sharply pointed, few in number, varying from eight to two, those with only two actines being frequently microxeas; a single actine of a triod form 0·064 mm. in length.

6. *Subcortical oxeate spheraster;* this form is intermediate between the two preceding; centrum well developed, actines numerous, sharply pointed, conical, rarely faintly and minutely spined near the extremities, a single actine 0·01 mm. in length; total diameter, 0·035 mm.

Colour.—Yellowish-white.

Habitat.—Station 56, off Bermuda, May 29, 1873; lat. 32° 8′ 45″ N., long. 64° 59′ 35″ W.; depth, 1075 fathoms; bottom, coral mud; bottom temperature, 38°·2. Dredged.

Remarks.—A single imperfect specimen of this sponge was dredged; it has grown over the hard skeleton of a species of *Isis*, the polyps of which are still present at one end; a part of the polypary has extended itself over the surface of the sponge. In the characters of its spicules the sponge resembles *Geodia megastrella*, Carter, and in the structure of the cortex it brings to mind *Cydonium hirsutus*, Sollas. It is readily distinguished from both these species by the characters of the chones, which are those of an *Isops*.

The cortex is 1·68 mm. in thickness, it consists almost entirely of the sterrastral layer.

The ectochrote and the inner fibrous layer are both very thin; the former consisting of the outer epithelium and a single layer of underlying spherasters.

The chones open to the exterior by a single poral canal about 0·16 mm. long, which centrally perforates a thick muscular sphincter; for the inner half of their course they are reduced to a very narrow canal, 0·8 mm. long, which runs through a muscular sphincter, about 0·32 mm. in diameter in the instance measured. The outer margin of the sphincter is not in immediate contact with the sterrasters of the sterrastral layer, but passes into a fibrous collenchyma. The poral canal is lined by a layer of spherasters (4) beneath the epithelium; the endochonal canal by a mixture of astral forms, oxyasters (5), oxeate spherasters (6), and spherasters of larger size than those of the ectochrote, one measuring as much as 0·024 mm. in diameter, but otherwise similar.

The choanosome contains numerous embedded foreign bodies, including spicules of other sponges; amongst the latter is a tylostyle bearing recurved spines, and this occurs also incorporated with the cortex.

The flagellated chambers are comparatively large and the aphodal canals wide and unusually long, their length depending on the distance of the chamber from the nearest excurrent canal. Many of the chambers measure 0·0355 mm. in breadth by 0·0316 mm. in length, the prosopyle 0·016, and the apopyle from 0·02 to 0·0276 mm. in diameter.

Supplemental Account of Species not in the Challenger Collection.

Family I. Geodiidæ.

Subfamily 1. Erylina.

Erylus discophorus (O. Schmidt).

Stelletta discophora, O. Schmidt, Spong. Adriat. Meeres, p. 47, pl. iv. fig. 5, 1862.
Triate discophora, Gray, Proc. Zool. Soc. Lond., p. 549, 1867.

Sponge.—A very irregular, flattened, tuberose mass. Cortex thin, 0·2 to 0·25 mm. in thickness. Skeleton consisting chiefly of tangentially disposed oxeas and sterrasters, covered externally by an ectochrotal felt of microstrongyles, which also line the sides of the chones. Chones simple cylindrical tubes, opening to the exterior by a single pore, from 0·08 to 0·24 mm. in diameter, and to the interior by an apparently sphinctrate aperture which lies in the intercladal area formed by the cladomes of the dichotriænes. Oscules (?). Choanosome; canals furnished with numerous velar diaphragms. Skeleton consisting of oxeas, partly scattered, partly arranged in thick bundles having no definite direction, except on approaching the cortex, towards which they are directed at right angles; of dichotriænes, some of which are irregularly scattered through the sponge, and others

directed at right angles to the cortex, which they support by their cladomes; and of oxyasters, which commence at the chonal sphincters where the microstrongyles cease to appear.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, sharply pointed, occasionally strongylate at one or both ends, 1·06 to 1·24 by 0·035 mm. 2. *Dichotriæne*, rhabdome conical, sharply pointed, 0·556 by 0·0516 mm.; protocladi from 0·127 to 0·143 mm. long; deuterocladi from 0·175 to 0·368 mm. long.

II. Microscleres. 3. *Sterraster*, discoform, thin, circular or elliptical in outline, actines forming radiating rounded ridges on the more or less flat face, surface granulated; 0·084 to 0·106 by 0·077 mm., and 0·015 mm. thick. 4. *Oxyaster*, no definite centrum, actines slender, conical, smooth, varying in number from three to twelve, a single actine 0·023 mm. in length. 5. *Microstrongyle*, fusiform or cylindrical, centrotylote or not, surface roughened, 0·028 by 0·0035 mm.

Colour.—Black internally, owing to the presence of pigment-cells in the cortex.

Habitat.—Lesina, Adriatic (O. Schmidt); north-west Spain (Saville Kent).

Remarks.—The measurements of the spicules were obtained from a type-slide in the British Museum, and checked by others mounted by myself from a dry specimen kindly presented me by Professor von Graff. There is another slide labelled *Stelletta discophora*, O. S., Florida, amongst those presented to the British Museum by Oscar Schmidt; but its spicules appear to more closely resemble those of *Erylus euastrum*, O. Schmidt. A specimen referred to *Erylus discophorus* by Saville Kent, who dredged it off the north-west coast of Spain, occurs in the Kent Collection of the British Museum (No. 21, registered No. 72. 5. 4). This I have not examined.

Erylus mammillaris (O. Schmidt).

Stelletta mammillaris, O. Schmidt, Spong. Adriat. Meeres, p. 48, pl. v. fig. 1, 1862, and Suppl., iii. p. 20, 1868.
Erylus mammillaris, Gray, Proc. Zool. Soc. Lond., p. 549, 1867.

Sponge.—Growing from a widely extended base into a number of mammillary lobes, each of which bears a single large oscule at the extremity. Pores each the single opening of an incurrent chone. Cortex thin. Microstrongyles occur throughout the choanosome as well as beneath the epithelium of the cortex.

Spicules.—I. Megascleres. 1. *Oxea*, curved or sinuous, 1·5 by 0·032 mm. 2. *Dichotriæne*, rhabdome conical, oxeate, 0·716 by 0·044 mm.; protocladi 0·09 by 0·036 mm.; deuterocladi 0·09 mm. long.

II. Microscleres. 3. *Sterraster*, ellipsoidal, the ends of the actines covered with rounded granules; 0·106 by 0·043 by 0·032 mm. in diameter, or less elongated and wider, 0·0775 by 0·0516 mm. 4. *Choanosomal spheraster*, centrum small, actines conical,

oxeate; 0·019 mm. in diameter. 5. *Somal microstrongyle*, cylindrical or fusiform, centrotylote or not, surface roughened, 0·0237 by 0·004 mm.

Colour.—Black externally.

Habitat.—Quarnero, Adriatic; Algiers.

Remarks.—This species is distinguished from *Erylus discophorus*, O. Schmidt, by the form of the sterraster, and the presence of microstrongyles throughout the choanosome. The measurements of the spicules were taken from a type-slide of the Adriatic example in the British Museum collection, and confirmed from preparations mounted by myself from a specimen presented me by Professor von Graff. The Algerian sponge of the same species is represented by a slide in the British Museum; it is probably correctly identified by Schmidt, though the spicules are of somewhat different dimensions; my measurements are as follows:—Oxea, 1·0 by 0·016 mm.; dichotriæne, rhabdome 0·46 mm. long; proto- and deuterocladi, each 0·108 mm. long; microstrongyle 0·057 by 0·005 mm.

Erylus carteri, n. sp.

Stelletta euastrum, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 489, pl. vii. fig. 41, 1880.

Sponge.—Lamelliform, thin, incrusting, surface even; oscules distinct, scattered singly or collected in groups.

Spicules.—I. Megascleres. 1. *Oxea*, 0·85 by 0·028 mm. 2. *Orthotriæne*, sometimes passing into a *dichotriæne;* rhabdome 0·56 by 0·056 mm.

II. Microscleres. 3. *Sterraster*, disciform, elliptical, very thin, actines minutely spined at the ends, 0·24 mm. long by 0·127 mm. broad and 0·042 mm. thick. 4. *Chiaster*, 0·028 mm. in diameter. 5. *Microxea*, centrotylote.

Colour.—Greyish-white.

Habitat.—Gulf of Manaar.

Erylus lendenfeldi, n. sp.

Stelletta euastrum, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 490, pl. vii. fig. 42, 1880.

Sponge.—Ovate; surface even, dimpled; pores 0·16 mm. in diameter, the simple openings of chones, generally dispersed; oscules distinct, of different sizes, irregularly distributed.

Spicules.—I. Megascleres. 1. *Oxea* or *strongyle*, 0·80 by 0·025 mm. 2. *Orthotriæne*, rhabdome strongylate, 0·316 by 0·0276 mm.; cladi 0·15 mm. long.

II. Microscleres. 3. *Sterraster*, ellipsoidal, depressed, from 0·10 by 0·065 to 0·135 by 0·058 mm. 4. *Chiaster*, actines few, slender, tylote, sometimes minutely spined, 0·03 mm. in diameter. 5. *Oxyaster*, actines usually four in number, minutely over the

distal half, 0·10 mm. in diameter. 6. *Microstrongyle*, fusiform, centrotylote, 0·047 by 0·006 mm.

Colour.—White externally, pale yellow within. Size, 76 mm. long by 38 mm. wide.

Habitat.—Freemantle, South Australia.

Erylus cylindrigerus, Ridley.

Erylus cylindrigerus, Ridley, Spong. "Alert," p. 626, pl. liii. fig. 17, pl. liv. fig. 2, 1884.

Sponge.—Massive, rising from a spreading base into a cylindrical or finger-like column, 30 mm. high by 12 mm. in diameter, bearing a single oscule at the apex. Pores the simple openings of incurrent chones, 0·2 mm. in diameter. Cortex, 0·1 mm. in thickness, composed of several layers of sterrasters, with a felt of microxeas beneath the epithelium. Microxeas and asters dispersed through the choanosome.

Spicules.—I. Megascleres. 1. *Strongyle*, fusiform, 0·7 by 0·032 mm. 2. *Orthotriæne*, rhabdome 0·29 by 0·0194 mm., cladi 0·232 mm. in length.

II. Microscleres. 3. *Sterraster*, lozenge-shaped, actines bearing minute spines, about 0·012 mm. apart; length 0·21 to 0·28 mm., breadth 0·1 to 0·14 mm.; thickness 0·032 mm. 4. *Oxyaster*, with conical minutely spined actines, 0·0237 mm. long, passing into 5. *Spheraster*, with more numerous shorter actines, 0·024 mm. in diameter. 6. *Microxea*, fusiform, centrotylote or not, smooth, 0·06 by 0·0032 mm.

Colour.—Dark-brown, almost black, in spirit specimens; produced by pigment-cells in the cortex.

Habitat.—Providence Reef, Mascarene Islands; depth, 24 fathoms; bottom, sand and dead coral.

Remarks.—I have adopted most of Ridley's measurements of the spicules of this sponge. The orthotriæne which Ridley thought was absent is readily found in thick slices, but it is not very common. The young forms of the sterraster present themselves as excessively thin smooth discs, composed of trichital actines, radiating in a single plane. The hilum in the adult sterraster is represented by an oval, smooth, central space, devoid of spines.

THE FOLLOWING THREE SPECIES OF ERYLUS ARE INSUFFICIENTLY CHARACTERISED :—

Erylus mastoideus (O. Schmidt).

Stelletta mastoideus, O. Schmidt, Spong. Meerb. v. Mexico, p. 70, pl. x. fig. 1, 1880.

Sponge.—Massive, lobed, bearing a single oscule on each lobe; surface roughened by the points of protruding spicules. Oscule surrounded by a circular, contractile, membranous margin. Cortex consisting externally of a felt of large fusiform spicules, which likewise form the spicular fibres of the interior. Canal walls lined with microstrongyles.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform. 2. *Dichotriæne.*

II. Microscleres. 3. *Sterraster.* 4. *Oxyaster* (?), with slender actines. 5. *Microstrongyle.*

Habitat.—Grenada; depth, 262 fathoms.

Erylus transiens (Weltner).

Stelletta transiens, Weltner, Beiträge zur Kenntniss d. Spong. (Freiburg), p. 44, pl. ii. figs. 22–25, 1882.

Sponge.—Conical, 20 mm. long by 10 mm. wide, excavated by an axial cavity, with walls 3 mm. in thickness; or somewhat cylindrical, solid.

Spicules.—I. Megascleres. 1. *Oxea;* some of the oxeas traverse the cortex. 2. *Dichotriæne*, deuterocladi short compared to the protocladi; rhabdome variable in length.

II. Microscleres. 3. *Sterraster*, disciform, biconvex. 4. *Spheraster*, a small centrum and numerous conical actines, 0·0162 mm. in diameter. 5. *Microstrongyle*, fusiform, centrotylote; 0·05 mm. long.

Colour.—Pure white in the dried state.

Habitat.—Barbados; depth, 100 fathoms (Agassiz, 1878); and Gulf of Mexico (Agassiz, 1879).

Erylus (?) *intermedia* (O. Schmidt).

Stelletta intermedia, O. Schmidt, Spong. Algier, p. 21, pl. iv. fig. 6, 1868.

Sponge (?).—Cortex 1 mm. in thickness.

Spicules.—I. Megascleres. 1. *Oxea.* 2. *Orthotriæne.*

II. Microscleres. 3. *Sterraster*, spherical; 0·11 mm. in diameter. 4. *Chiaster*, actines truncated, and covered near the ends with little tubercles. 5. *Oxyaster*, actines granulated. 6. *Microxea*, surface granulated; 0·075 mm. long.

Habitat.—Algiers.

Caminus vulcani, O. Schmidt.

Caminus vulcani, O. Schmidt, Spong. Adriat. Meeres, p. 48, pl. iii. fig. 27; pl. iv. fig. 6, 1862.

Sponge.—Spherical; surface smooth, covered with a network of elevated ridges; bearing little tubercles; oscule single, large, situated at the summit of the sponge, surrounded by a smooth thin margin, leading into a vertically descending cloaca, the upper one-third of which is smooth, that below perforated by numerous excurrent canals; pores in sieves between the ridges. Cortex scarcely 2·1 mm. thick, ectochrote very thin.

Spicules.—I. Megascleres. 1. *Strongyle*, 0·8 by 0·016 mm. 2. *Orthotriæne*, rare, 0·48 and over by 0·016 mm., cladi 0·32 mm. long and over.

II. Microscleres. 3. *Sterraster*, spherical, depressed; 0·10 mm. in diameter. 4. *Oxyaster*, with but few slender actines, which are sometimes not more than two in number, and thus indistinguishable from centrotylote microxeas; a single actine of a triradiate form 0·039 mm. in length, a microxea 0·079 mm. in length. 5. *Spherules*, 0·0039 mm. in diameter.

Colour.—Blackish-brown above where exposed to the light, whitish below.

Habitat.—Sebenico, Adriatic; depth, 7 fathoms.

Genus 3. *Pachymatisma*, Bowerbank.

The oscules are the single openings of cloacal chones, which lead each into a large cloacal cavity beneath the chonal sphincter. The incurrent chones are cribriporal. The somal microsclere is a microstrongyle.

Pachymatisma johnstonia, Bowerbank.

Alcyonium primum, Diosc. (?), Donati, Hist. Mer. Adriat., 1758.
Halichondria johnstonia, Bowerbank, Trans. Micr. Soc. Lond., vol. i. p. 63, pl. vi., 1841.
„ „ Johnston, Hist. Brit. Spong., p. 198, 1842.
Pachymatisma johnstonia, Bowerbank, Mon. Brit. Spong., vol. i. pl. xxvii. fig. 353, 1864; vol. ii. pp. 3, 51, 1866; vol. iii. p. 17, pl. viii. figs. 1–7, 1874.
„ „ O. Schmidt, Spong. Adriat. Meeres, Suppl., ii. p. 12, 1866.
„ „ Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. iv. p. 11, 1869.
Caminus osculosus,[1] Grube, Mitth. ü. St. Malo u. Roscoff, p. 132, pl. ii. fig. 3, 1873.
non Pachymatisma johnstonia, Hansen, Spong. Norweg. North Atlant. Exped., p. 17, pl. iv. fig. 15, 1885.

Sponge.—Massive, raised into undulating ridges, sessile, surface smooth; oscules and pores distributed over different areas, the oscules usually occupying the summits of the ridges. Cortex about 1 mm. in thickness, sterrastral layer thin, ectochrote well developed.

Spicules.—I. Megascleres. 1. *Strongyle*, usually cylindrical, straight or curved, sometimes irregularly; 0·63 mm. long (B.), 1·03 by 0·013 mm. (S.), 0·924 by 0·013 mm. (R.). 2. *Orthotriæne*, rhabdome conical, oxeate or strongylate, 0·44 mm. long. (B.), 0·636 by 0·016 mm. (S.), 0·44 by 0·019 (R.); cladi conical or cylindrical, oxeate or strongylate, 0·13 mm. long (S.), 0·238 mm. (R.).

II. Microscleres. 3. *Sterraster*, ellipsoidal, 0·12 mm. long. (B.), 0·097 by 0·0838 mm. (S.), 0·9 by 0·071 mm. (R.). 4. *Oxyaster*, actines not numerous, conical, finely spined,

[1] I add here a reference to the following memoir, which I have been unable to consult:—Koehler, R., Remarques sur le genre Caminus et sur une éponge voisine du Caminus osculosus, Grube (Paris, G. Masson, 1884).

0·054 mm. in diameter (B.), 0·063 mm. (S.), 0·06 mm. (R.). 5. *Microstrongyle*, minutely spined, centrotylote or not, 0·03 mm. long (B.), 0·0236 mm. (S.), 0·0316 by 0·005 mm. (R.).

Colour.—Slate-grey on the portion exposed to the light, almost white beneath; specimens from considerable depths pink or red (Bowerbank).

Habitat.—Rocks between high and low water mark, Torquay, Guliot Caves, south coast of Ireland (Bowerbank); near Plymouth, south coast of England (Stewart); Budleigh Salterton, Devonshire (Carter); the island of Douon, about four miles north-east of Roscoff, Brittany, at low water of highest spring tides (Sollas); St. Malo, Brittany (Grube).

Remarks.—The letters given after the dimensions of the spicules signify as follows—(B.) measurements from Bowerbank's description and figures; (S.) from a specimen presented me by Professor Stewart; (R.) from a specimen obtained by myself from Douon, Roscoff. Bowerbank assigns certain specimens which he received from the Orkney Islands and Wick, Scotland, to this species, and I have made the same identification of specimens placed in my hands by Dr. Norman, and obtained by him from Kors Fjord, Norway. Further examination of these last has led me to regard them as the type of a new species, to be next described; this helps to sustain the distinction which I have already suggested as existing between the sponge fauna of the North German Ocean and of the English Channel.

The colour of the sponge is due to pigment-cells richly scattered through the cortex; oil-bearing cells also occur in this region.

Pachymatisma johnstonia, Hansen, appears to belong to a different genus.

Pachymatisma normani, n. sp.

Pachymatisma johnstonia, Bowerbank (in part), *loc. cit.*
„ „ Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. ix. p. 141, pl. vi., 1882.
„ „ Norman, Mon. Brit. Spong., Bowerbank, vol. iv. p. 28, 1882.

Sponge.—Similar to *Pachymatisma johnstonia*, Bowerbank, but with a relatively thicker sterrastral layer in the cortex.

Spicules.—I. Megascleres. 1. *Strongyle*, fusiform, curved, sometimes irregularly, 1·68 by 0·0276 mm. 2. *Orthotriæne*, rhabdome 0·83 by 0·026 mm., cladi 0·446 mm. long.

II. Microscleres. 3. *Sterraster*, ellipsoidal, 0·2 by 0·16 mm. 4. *Oxyaster*, actines few, conical, somewhat coarsely spined; diameter 0·08 mm. 5. *Microstrongyle*, cylindrical, minutely spined, 0·019 to 0·022 mm. long.

Colour.—Slate-grey in spirits, nut-brown when dry.

Habitat.—Kors Fjord, Norway; depth, 180 fathoms (Norman). Orkney Islands; depth, 35 fathoms; and Wick, Scotland (Bowerbank). Burrafirth, Unst, Shetland (Norman).

Pachymatisma areolata, Bowerbank.

Pachymatisma areolata, Bowerbank, Proc. Zool. Soc. Lond., p. 630, pl. xlviii., 1872.

Sponge.—Massive, sessile; surface uneven "cloisoné" or raised into large anastomosing ridges which circumscribe shallow depressions. Oscules minute, numerous, congregated in deep areas within the depressions. Surface hispidated with somal and cortical oxeas. Cortex 0·95 mm. thick.

Spicules.—I. Megascleres. 1. *Somal rhabdus*, both oxeate, strongylate, and oxystrongylate, the oxea 22·3 mm. in length. 2. *Cortical oxea.* 3. *Orthotriæne.*

II. Microscleres. 4. *Sterraster*, subspherical, 0·11 mm. in diameter. 5. *Spheraster*, with short cylindrical actines, 0·013 mm. in diameter. 6. *Oxyaster* or *strongylaster*, 0·045 mm. in diameter. 7. *Somal microstrongyle*, 0·0065 mm. in length.

Colour.—Cream-white in the dried state. Size, 175 mm. long by 94 mm. wide, by 69 mm. thick.

Habitat.—Red Sea.

Subfamily II. Geodina.

Genus 4. *Geodia*, Lamarck.

The incurrent chones are furnished with cribriporal roofs. In the young sponge the oscule is the patent opening of a cloaca, into which the excurrent canals open by sphinctrate apertures; in the adult the cloaca may persist, or become converted into a shallow depression, which is usually surrounded by a more or less sharply defined margin.

Geodia gibberosa, Lamarck.

Geodia gibberosa, Lamarck, Mém. Mus. Hist. Nat. Paris, vol. i. p. 333, 1815.
" " Bowerbank (*in part*), Proc. Zool. Soc. Lond., p. 7, 1873.
" " Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 241, 1880.
non Geodia gibberosa, Duch. et Mich., Spong. Caraib., p. 105, pl. xxv. fig. 1, 1864.

Sponge.—Subglobose, surface covered with slight tubercular elevations. A single large oscule bounded by a well-marked marginal edge, the patent opening of an exposed circular cloaca, over the floor of which numerous excurrent tubes open.

Spicules.—I. Megascleres. 1. *Somal oxea.* 2. *Cortical oxea.* 3. *Orthotriæne.*

II. Microscleres. 4. *Sterraster*, spherical. 5. *Oxyaster*, large, with a small centrum. 6. *Spheraster*, small, actines cylindrical and truncated.

Size, from 125 to 150 mm. in diameter, cloaca from 37 to 50 mm. in diameter.

Habitat.—Martinique and Porto Rico, Antilles.

Remarks.—The observations of Dr. Bowerbank, who examined the original types of Lamarck's species in the Museum of the Jardin des Plantes, Paris, show incontestibly that in the character of its oscules it differs in no respect from those of *Geodia baretti*, Bowerbank, which I took for my type in redefining the genus *Geodia* (*loc. cit. supra*). It is satisfactory to be sure of so much; as for the rest, all is confusion. Bowerbank, in further describing the species, took for his type a specimen presented him by Dr. Fleming, who obtained it from the Island of Dominica: and he did this although possessing fragments of the original sponge. This of itself would be of no consequence were it not unfortunately the case that Fleming's sponge belongs to a different genus, viz., *Cydonium*. I was in hopes that an examination of Bowerbank's slides in the British Museum might help to set the matter right; but, singularly enough, these which in other cases are, as an almost invariable rule, correctly labelled, are, as regards this sponge, in a state of hopeless confusion. There are three of them—two are thick slices, the third bears separated spicules. No two are in agreement; the spicules differ from those in the slices and the slices differ from one another, one of them having evidently been taken from *Geodia barretti*, Bowerbank. Bowerbank states that the spicules in Dr. Fleming's specimen are identical in character with those of Lamarck's; and as we may accept this as probably true of the forms of the spicules, I have enumerated those alleged by Bowerbank to be present, but have refrained from adding measurements.

Section 1. *Pantœa.*[1]

Species possessing cortical as well as somal oxeas, and anatriænes or protriænes, or both, in addition to orthotriænes or dichotriænes.

Geodia perarmata, Bowerbank.

Geodia perarmata, Bowerbank, Proc. Zool. Soc. Lond., p. 8, pl. ii. figs. 1–11, 1873.
„ „ Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 131, pl. vi. figs. 32–35, 1880.

Sponge.—Spherical or massive, sessile; cortex 0·48 mm. in thickness; oscules and pores as in *Geodia barretti*.

Spicules.—I. Megascleres. 1. *Somal oxea*, 2·0 by 0·0375 mm. (B.). 2. *Cortical oxea*, 0·225 mm. long (B.). 3. *Dichotriæne*, rhabdome 2·68 by 0·064 mm., protocladi

[1] παντοῖος, of all kinds, in allusion to its many varieties of spicules.

0·09 mm., deuterocladi 0·21 mm. long (S.); rhabdome 2·06 mm. long (B.). 4. *Anatriæne.*

II. Microscleres. 5. *Sterraster,* ellipsoidal, 0·088 by 0·064 mm. 6. *Somal chiaster,* with short, cylindrical, truncate rays, 0·006 mm. in diameter. 7. *Choanosomal spheraster,* centrum small, actines conical, oxeate, minutely spined near the ends; diameter 0·035 mm.

Colour.—Cream-yellow in the dried state. Size, the specimen figured by Bowerbank is 25 mm. in diameter.

Habitat.—Unknown (Bowerbank); Gulf of Manaar (Carter).

Remarks.—The letter (B.) after measurements indicates that they were taken from Bowerbank's illustrations.

Mr. Carter has described a specimen from the Gulf of Manaar, which he identifies with this species. The dimensions of the spicules in this, as given by Carter, are as follows:—I. Megascleres. *Somal oxea,* 2·8 by 0·056 mm.; *cortical oxea* not seen; *dichotriæne,* rhabdome 3·9 by 0·085 mm., chord 0·7 mm.; *pro-* and *ana-triæne,* cladi 0·07 mm. long. II. Microscleres. *Sterraster,* 0·1 mm. in diameter; *somal chiaster,* 0·0085 mm. in diameter; *choanosomal spheraster,* 0·0254 mm. in diameter. The sterrastral layer is stated to be 0·317 mm. in thickness, and the size of the largest specimen 25 mm. in diameter. These measurements appear to be sufficiently accordant, and I have but little doubt of the correctness of Carter's identification.

Geodia areolata, Carter.

Geodia areolata, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 133, pl. vi. figs. 36, 37, 1880.

Sponge.—Globular, free or attached; surface areolated by lines of minute hispidating oxeas; oscules in groups or scattered singly here and there; pores in sieves generally distributed; cortex 0·71 mm. thick.

Spicules.—I. Megascleres. 1. *Somal oxea,* 2·11 by 0·042 mm. 2. *Cortical oxea,* 0·25 mm. in length. 3. *Orthotriæne,* rhabdome 2·8 by 0·07 mm. 4. *Pro-* and 5. *Anatriæne,* both with cladi about 0·07 mm. long.

II. Microscleres. 6. *Sterraster,* ellipsoidal, 0·0888 by 0·0676 mm. 7. *Somal spheraster,* 0·0042 mm. in diameter. 8. *Choanosomal spheraster,* centrum minute, actines long and slender, diameter 0·017 mm.

Colour.—Light cinnamon-brown. Size, 25 mm. in diameter.

Habitat.—Gulf of Manaar.

Remarks.—The measurements are taken from Carter's description. I have not seen the sponge, and am doubtful whether it is a true *Geodia.*

Geodia barretti, var. *nodastrella*, Carter.

Geodia nodastrella, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 397, pl. xvi. fig. 45, 1876.

Sponge.—Spherical when young, irregularly tuberose when large; free or attached; oscules the patent openings of shallow cloacas having cribriform walls; pores in sieves, small, 0·0276 to 0·055 mm. in diameter, generally distributed; cortex 0·607 mm. in thickness. Ectochrote containing spherasters and traversed by cortical oxeas; the somal oxeas frequently pierce the cortex.

Spicules.—I. Megascleres. 1. *Somal oxea*, 2·68 by 0·07 mm. 2. *Cortical oxea*, 0·31 by 0·007 mm. 3. *Dichotriæne*, rhabdome 2·39 by 0·112 mm., chord 0·756 mm. long. 4. *Ana-* and 5. *Pro-triæne*, cladi about 0·127 mm. in length.

II. Microscleres. 6. *Sterraster*, spherical or ellipsoidal, 0·10 mm. in diameter. 7. *Somal spheraster*, actines reduced to rounded tubercles, 0·0085 mm. in diameter. 8. *Choanosomal oxyaster*, with conical actines, 0·0127 mm. in diameter.

Colour.—Yellowish-white.

Habitat.—In deep water between the north of Scotland, the north-west of Shetland, and the Færöe Islands; Stations 51, 57, 61–63, and 65, "Porcupine" expedition, 1869; and near Cape St. Vincent.

Geodia carteri, n. sp.

Geodia canaliculata, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xi. p. 346, pl. xiv. fig. 1, 1883.

Sponge.—Subspherical, oscules in scattered groups; cortex thick.

Spicules.—I. Megascleres. 1. *Somal oxea*, 2·8 by 0·053 mm. 2. *Cortical oxea*, 0·25 mm. in length. 3. *Dichotriæne*, rhabdome 2·667 by 0·067 mm., chord 0·684 mm. 4. *Anatriæne*, cladi 0·112 mm., chord 0·14 mm. long.

II. Microscleres. 5. *Sterraster*, spherical, 0·078 mm. in diameter. 6. *Spheraster*, centrum large, actines short, cylindrical, spined at the edges of the truncate ends, 0·034 mm. in diameter. 7. *Chiaster*, 0·0042 mm. in diameter.

Colour.—Light fawn colour. Size, 75 mm. in diameter.

Habitat.—Adelaide, south-west of Australia.

Remarks.—This account is drawn up from Carter's description and figures (*loc. cit.*). The species appears to be similar to Schmidt's *Geodia canaliculata*, but there is not sufficient evidence of their identity, and I propose to direct attention to this fact by naming the present sponge anew, after its describer.

Geodia megastrella, Carter.

Geodia megastrella, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 400, pl. xvi. fig. 46, 1876.

Sponge.—Hemispherical, elongate, flattened at the base, attached. Oscule on the summit. Cortex, 0·876 mm. thick, ectochrote very thin; cortical oxeas rare.

Spicules.—I. Megascleres. 1. *Somal oxea*, 2·95 by 0·042 mm. 2. *Cortical oxea*, 0·191 and over by 0·007 mm. 3. *Orthotriæne*, occasionally replaced by a dichotriæne, rhabdome 2·8 by 0·07 mm., cladi 0·67 by 0·07 mm. 4. *Ana-* and 5. *Pro-triæne*, similar to those of *Geodia barrettii*, var. *nodastrella*, Carter.

II. Microscleres. 6. *Sterraster*, ellipsoidal, 0·183 mm. in diameter. 7. *Somal chiaster*, very variable, actines short, cylindrical, strongylate, or tylote; sometimes a small centrum is present, 0·008 mm. in diameter. 8. *Choanosomal oxyaster*, with from three to eight long, conical actines, minutely spined, a single actine 0·063 by 0·004 mm.

Colour.—Grey in the dried state.

Habitat.—Station 25, "Porcupine" expedition, 1870, near Cape St. Vincent; depth, 374 fathoms.

Remarks.—The size of the sterraster and the characters of the somal chiaster distinguish this from *Geodia barrettii*, var. *nodastrella*, Carter. In my sections the cortex also has a very different appearance to that in the last-named species, owing to the thinness of the ectochrote and the absence of brushes of cortical oxeas, which only occur singly.

Geodia (?) *megastrella*, var. *levispina*, Carter.

Geodia megastrella, var. *levispina*, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 401, pl. xvi. fig. 47, 1876.

This variety is founded on a fragment of the cortex, about 25 mm. square, with a little of the choanosomal tissue adherent. The sterraster is intermediate in size between that of *Geodia nodastrella* and *Geodia megastrella*, viz., 0·154 mm. in diameter, and the actines of the oxyaster are smooth, not spined. The orthotriæne is said to be smaller than that of the last-named species, but it is obviously impossible to obtain reliable measurements from such a small fragment as that which Carter had under examination.

Geodia placenta, O. Schmidt.

Geodia placenta, O. Schmidt, Spong. Adriat. Meeres, p. 49, pl. iv. fig. 7, 1862.

Sponge.—Tuberose, depressed, or forming thick, incrusting, cake-like masses; surface finely or densely hispid; cortex from 1 to 3 mm. in thickness, consisting of an ecto-

chrote 0·08 to 0·118 mm. in thickness (composed of vesicular tissue, containing beneath the epithelium a single layer of minute chiasters) of the sterrastral layer, and an inner fibrous layer 0·16 to 0·238 mm. in thickness. Pores in sieves hispidated by cortical oxeas, leading into incurrent chones. Oscules as in *Geodia barretti*, Bowerbank, margins hispidated by cortical oxeas.

Spicules.—I. Megascleres. 1. *Somal oxea*, 2·84 by 0·044 mm. (B. M.), and from 3·18 by 0·0473 to 3·51 by 0·0276 mm. 2. *Cortical oxea*, 0·39 by 0·008 mm. 3. *Orthotriæne*, rhabdome 2·76 by 0·07 mm. (B. M.), and 3·57 by 0·0513 mm., cladus 0·254 mm. long. 4. *Anatriæne*, rhabdome 4·82 by 0·019 mm. (B. M.), and 6·36 by 0·0197 mm., cladome variable, cladi sometimes extending outwards at right angles from the rhabdome for nearly half their length before recurving backwards, sometimes extending outwards and backwards from their origin; an example of the latter gave the following measurements—cladus 0·063 mm. long, chord 0·09 mm., sagitta 0·059 mm.; one of the former, cladus 0·0315 mm. long, chord 0·0513 mm., sagitta 0·0479 mm., and another, cladus 0·0316 mm. for the horizontal part of its course, 0·0434 for its backwardly directed terminal part, chord 0·083 mm., sagitta 0·0474 mm.

II. Microscleres. 5. *Sterraster*, 0·071 mm. in diameter (B. M.) and 0·067 mm. 6. *Somal chiaster*, actines short, cylindrical, truncated at the ends, 0·01 mm. in diameter. 7. *Choanosomal chiaster*, 0·0237 mm. in diameter.

Colour.—Cream-yellow in the dried state.

Habitat.—Quarnero, Adriatic.

Remarks.—The measurements marked (B. M.) were obtained from a type-slide in the British Museum collection, the others from a large fragment presented me by Professor von Graff. They do not accord very closely, but this is possibly due to the spicules having been obtained from sponges of different size. In its general characters the sponge resembles *Geodia barretti*, Bowerbank. I received two specimens of Schmidt's type from Professor von Graff; in one of them the cortex is only 1 mm. thick and abundantly furnished with chones, but not traversed by the megascleres or only rarely so, while in the other the cortex is 3 mm. thick, and hispidated by oxeas and anatriænes, which pass in great numbers through its substance, and project nearly 2 mm. beyond the surface; no chones are present in the cortex of this specimen, except those of the oscules, which occur in a shallow depressed area, formed of modified cortex.

Geodia tumulosa, Bowerbank.

Geodia tumulosa, Bowerbank, Proc. Zool. Soc. Lond., p. 628, pl. xlvii., 1872.
Geodia gibberosa, Lamarck, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. ix. p. 362, 1882.

Sponge.—Massive, sessile, tumulose. Oscular areas situated on the ends of the tumulous projections; surface minutely hispidated. Cortex, 1·43 mm. in thickness, con-

sisting chiefly of the sterrastral layer; ectochrote thin, traversed by numerous hispidating cortical oxeas.

Spicules.—I. Megascleres. 1. *Somal oxea*, 3·2 by 0·058 mm. 2. *Cortical oxea*, 0·33 to 0·5 by 0·006 mm. 3. *Orthotriæne*, rhabdome 3·25 by 0·08 mm., cladi 0·4 mm. long. 4. *Protriæne*, rhabdome fusiform, 4·0 mm. long and probably over, by 0·0193 mm. near the cladal origin, and 0·0258 mm. where thickest, cladi 0·206 mm., chord 0·143 mm., sagitta 0·191 mm.; rhabdome sometimes produced 0·08 mm. beyond the cladal origin. 5. *Anatriæne*, rhabdome cylindroconic, often strongylate, 4·5 by 0·025 mm., cladi 0·16 mm., chord 0·143 mm., sagitta 0·122 mm.

II. Microscleres. 6. *Sterraster*, spherical, 0·064 mm. in diameter. 7. *Somal spheraster*, actines minute, short, cylindrical, strongylate; 0·013 mm. in diameter. 8. *Choanosomal oxyaster*, actines conical, not numerous, a single actine 0·0258 mm. long. 9. *Subcortical* (?) *spheraster*, a well-marked centrum and somewhat numerous, stout cylindrical actines, spined near the ends and truncate.

Size, 213 mm. long by 113 mm. broad; another specimen 69 mm. in thickness.

Habitat.—Honduras and Jamaica.

Geodia barretti, Bowerbank.

Geodia Barretti, Bowerbank, Phil. Trans. Roy. Soc., p. 279, 1858; *Ibid.*, pl. xxxii. fig. 2, 1862; Mon. Brit. Spong., vol. i. pp. 168, 171, pl. xxviii. fig. 354, 1864; Proc. Zool. Soc. Lond., p. 198, pl. xi. 1872.
Cydonium Barretti, Gray, Proc. Zool. Soc. Lond., p. 548, 1867.
Geodia Barretti, Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 241, pls. x.–xii., 1880.
Geodia Barretti, Vosmaer, Sponges of the "Willem Barents," p. 23, pl. iii. figs. 50, 51, pl. iv. figs. 120–122, 1881.

Sponge.—Spherical when young, with a single oscule with inflected margin leading into a deep cloaca, into which the excurrent canals open by sphinctrate mouths through walls which resemble the cortex in structure; massive and sessile when of larger growth, with one or more oscules, which are the patent openings of a wide shallow cloaca. Cortex 0·6 mm. (B.), and 0·4 mm. (S.) thick, with a well-developed ectochrote 0·238 mm. (B.), 0·075 mm. (S.) thick, traversed by cortical oxeas which hispidate the surface; sterrastral layer 0·318 mm. (B.), 0·250 mm. (S.) thick, and inner fibrous layer 0·075 mm. (S.) thick.

Spicules.—I. Megascleres. 1. *Somal oxea*, 3·6 by 0·058 (B.) to 3·6 by 0·071 mm. (S.). 2. *Cortical oxea*, 0·387 mm. in length (B.), 0·387 by 0·01 mm. (S.). 3. *Dichotriæne*, rhabdome 4·1 by 0·1 mm. (B.), 2·3 by 0·071 mm. (S.); protocladi 0·286 mm., deuterocladi 0·32 mm. long (B.), chord 0·61 mm. (S.). 4. *Anatriæne*, rhabdome 4·46 by 0·013 mm. (B.) by 0·0145 mm. (S.); cladi 0·167 mm., chord 0·116 mm. long (B.), cladi 0·13 mm., chord 0·08 mm. long (S.). 5. *Protriæne*.

II. Microscleres. 6. *Sterraster*, spherical, 0·064 and 0·077 mm. (B.), 0·070 and

0·095 mm. (S.). 7. *Somal spheraster*, minute, centrum confluent with short, cylindrical rounded actines, 0·008 mm. in diameter. 8. *Choanosomal oxyaster*, centrum small, confluent with conical, minutely-spined or roughened actines, 0·05 mm. in diameter.

Colour.—Deep cream-yellow. Size, 213 mm. by 125 mm. by 50 mm.

Habitat.—Norway, Vigten Island; depth, 100 fathoms (Bowerbank). Norway, Kors Fjord; depth, 180 fathoms (Norman). Near Hammerfest; lat. 71° 12′ N., long. 20° 30′ E.; depth, 135 fathoms (Vosmaer).

Remarks.—The letter (B.) placed after a measurement indicates that it was taken from one of Bowerbank's type-slides in the British Museum; (S.) that it was taken from a small sponge, 25 mm. in diameter, described by the author (*loc. cit.*, *vide supra*).

Geodia tuberculosa, Bowerbank.

Geodia tuberculosa, Bowerbank, Proc. Zool. Soc. Lond., p. 626, pl. xlvi., 1872.

Sponge.—Massive, sessile, somewhat cup-shaped, surface produced into tubercular prominences; hispidated by somal and cortical oxeas. Oscules simple, small, numerous, collected in deep cavities. Cortex thin, from 0·52 to 0·7 mm. in thickness.

Spicules.—I. Megascleres. 1. *Somal oxea*, 2·1 by 0·037 mm. 2. *Cortical oxea*, curved, 0·405 mm. in length. 3. *Orthotriæne*, rhabdome 0·044 mm. in diameter, cladi 0·244 mm. long. 4. *Protriæne*, rhabdome 0·024 mm. in diameter, cladi 0·15 mm. long. 5. *Anatriæne*, cladi 0·162 mm. long, chord 0·161 mm., sagitta 0·145 mm.

II. Microscleres. 6. *Sterraster*, small. 7. *Somal spheraster*, centrum small, actines bacillary, truncate, diameter 0·015 mm. 8. *Choanosomal spheraster*, centrum well marked, actines cylindrical, thick, strongylate, densely spined, spines large, conical, diameter 0·061 mm. 9. *Choanosomal strongylaster*, centrum not enlarged, actines conical, slender, strongylate, diameter 0·032 mm.

Colour.—(?). Size, 131 mm. in height by 100 mm. in maximum diameter.

Habitat.—Mexico.

Remarks.—The measurements of the spicules are taken from Bowerbank's illustrations.

Section 2. *Dirabdosa.*

Species possessing both cortical and somal oxeas, but neither anatriænes nor protriænes.

Geodia paupera, Bowerbank.

Geodia paupera, Bowerbank, Proc. Zool. Soc. Lond., p. 329, pl. xxxi. figs. 16–21, 1873.

Sponge.—Massive, coating ; surface even, finely hispid ; cortex, 0·48 mm. in thickness, ectocortex thin, transversed by cortical oxeas and containing minute chiasters (4) ; the inner fibrous layer of the cortex well defined, 0·06 mm. in thickness.

Spicules.—I. Megascleres. 1. *Somal oxea*, 1·1 by 0·02 mm. 2. *Cortical oxea*, 0·254 mm. long. 3. *Orthotriæne*, rhabdome 1 mm. long.

II. Microscleres. 4. *Sterraster*, small, spherical, 0·054 mm. in diameter. 5. *Somal chiaster*, actines cylindrical, truncate, 0·0054 mm. in diameter. 6. *Choanosomal chiaster*, actines slender, cylindrical, truncate, 0·024 mm. in diameter.

Colour.—Cream-white in dried state.

Habitat.—Unknown.

Remarks.—This species is founded on a fragmentary specimen, scarcely complete enough for generic identification ; it appears however to bear oscules within a depressed area, like that of a true *Geodia*.

Section 3. *Ditriæna.*

Species from which cortical oxeas are absent ; but possessing anatriænes or protriænes, or both, in addition to orthotriænes or dichotriænes.

Geodia flemingii, Bowerbank.

Geodia flemingii, Bowerbank, Proc. Zool. Soc. Lond., p. 3, pl. i. figs. 1–8, 1873.

Sponge.—Massive, sessile, hollow within ; surface even, hispid ; oscules collected in a group near the base ; cortex 0·88 mm. in thickness ; ectochrote not seen, as the sponge is worn by attrition.

Spicules.—I. Megascleres. 1. *Strongyle*, cylindrical, or fusiform, 1·6 by 0·029 mm. 2. *Dichotriæne*, protocladus 0·06 mm. long, deuterocladus 0·052 mm. long. 3. *Anatriæne*, rhabdome 0·008 mm. in diameter, cladus 0·084 mm. long, chord 0·078 mm.

II. Microscleres. 4. *Sterraster*, more or less ellipsoidal, 0·1 mm. in diameter. 5. *Somal spheraster*, with short, cylindrical, truncate actines, 0·007 mm. in diameter. 6. *Choanosomal spheraster*, actines cylindrical, minutely spined, truncate ; 0·0254 mm. in diameter.

Colour.—Light cream-yellow in the dried state. Size, 44 mm. long, by 33 mm. broad, and 37 mm. high.

Habitat.—Port Elliot, Australia.

Remarks.—Measurements of the spicules and cortex were made from type-slides in the British Museum.

Geodia reticulata, Bowerbank.

Geodia reticulata, Bowerbank, Proc. Zool. Soc. Lond., p. 300, pl. xlvi. figs. 14–20, 1874.

Sponge.—Massive, sessile; surface smooth.

Spicules.—I. Megascleres. 1. *Oxea*, 1·75 by 0·019 mm. 2. *Orthotriæne*, 2 by 0·0312 mm., cladi 0·2375 mm. long; chord 0·45 mm. 3. *Protriæne*, cladi 0·25 mm. long; chord 0·12 mm., sagitta 0·206 mm. 4. *Anatriæne*, cladi 0·144 mm. long; chord 0·15 mm., sagitta 0·125 mm.

II. Microscleres. 5. *Sterraster*, spherical, small. 6. *Oxyaster*, centrum absent, actines conical, 0·0254 mm. in diameter. 7. *Pycnaster*, actines bacillary, truncate, 0·0085 mm. in diameter.

Colour.—Cream-white (dried).

Habitat.—Mexico.

Remarks.—The measurements of the spicules are taken from Bowerbank's illustration. The generic position of the sponge is doubtful; the groups of oscules are circumscribed by a definite margin as in genuine *Geodias*.

Geodia (?) *ramodigitata*, Carter.

Geodia ramodigitata, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 133, pl. v. fig. 31, 1880.

Sponge.—Cylindrical, branching into finger-like processes; surface covered with attached detritus; oscules in groups or scattered singly; pores in sieves, generally distributed; cortex, 1·55 mm. in thickness.

Spicules.—I. Megascleres. 1. *Oxea*, 1·77 by 0·056 mm. 2. *Orthotriæne*, rhabdome 2·25 by 0·056 mm., chord 0·338 mm. 3. *Pro-* and 4. *Anatriænes*, cladi 0·056 mm. long.

II. Microscleres. 5. *Sterraster*, ellipsoidal, 0·14 by 0·112 mm. 6. *Somal chiaster*, 0·0043 mm. in diameter. 7. *Choanosomal chiaster*, actines slender, not tylote, 0·034 mm. in diameter.

Colour.—In the dry state, grey. Size, 125 mm. long, greatest diameter 8 mm.

Habitat.—Gulf of Manaar.

Section 4. *Monotriæna.*

Species possessing but one form of oxea and one form of triæne. Of these species there are but two, both incompletely characterised. It is therefore doubtful whether any of the *Geodiæ* really belong to this section.

Geodia (?) *thompsoni*, O. Schmidt.

Geodia thompsoni, O. Schmidt, Spong. Atlant. Gebiet., p. 70, pl. vi. fig. 13, 1870.

Sponge (?).—Surface smooth.

Spicules.—I. Megascleres. 1. *Oxea*, 3·37 by 0·05 mm. 2. *Dichotriæne*, rhabdome 0·095 mm. in diameter, protocladi 0·213 by 0·095 mm., deuterocladi 0·416 by 0·07 mm.

II. Microscleres. 3. *Sterraster*, ellipsoidal, 0·178 by 0·142 mm. 4. Other *Asters* (?).

Habitat.—Cozera, Cuba; depth, 270 fathoms.

Remarks.—Such measurements as I could obtain from Schmidt's type-slide in the British Museum are given above. As to Schmidt's description, one must be content in saying that it is inadequate.

Geodia (?) *canaliculata*, O. Schmidt.

Geodia canaliculata, O. Schmidt, Spong. Algier., p. 21, pl. iv. fig. 7, 1868.
(?) Not *Geodia canaliculata*, Carter, see *Geodia carteri*, p. 247, *antea*.

Sponge (?).—No description given by the author.

Spicules.—I. Megascleres. 1. *Oxea*, 2·13 by 0·044 mm. 2. *Triæne* (?), no description given beyond the fact that it is subject to pathological variations.

II. Microscleres. 3. *Sterraster*, spherical, 0·057 mm. in diameter; 0·0385 mm. (O. Schmidt, *loc. cit.*, p. 21). 4. *Aster*, 0·025 mm. in diameter.

Habitat.—Algiers.

Remarks.—The type-slide in the British Museum, presented by Schmidt, does not contain a full complement of spicules; of those present measurements are given above.

Genus *Cydonium*, Fleming.

Cydonium mülleri, Fleming.

Alcyonium cydonium, Müller, Zool. Dan., vol. iii. pl. lxxxi. figs. 3, 4, 5*a*.
„ „ Jameson, Mem. Wern. Soc. Edin., vol. i. p. 563.
Cydonium mülleri, Fleming, British Animals, p. 516, 1828.
Geodia zetlandica, Johnston, Hist. Brit. Sponges, p. 195, pl. iii. figs. 3, 4, 1842.
„ „ Bowerbank, Mon. Brit. Spong., vol. ii. p. 45, 1866; vol. iii. p. 15, pl. vii., 1874.
„ „ Norman, Bowerbank, Mon. Brit. Spong., vol. iv. p. 27, 1882.
Cydonium mülleri, Gray, Proc. Zool. Soc. Lond., pp. 127, 492, 1867.
Cydonium zetlandicum, Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 241, 1880.
Cydonium mülleri, Vosmaer, Bronn's Thierreich, Porifera, p. 317, 1887.

Sponge.—More or less cylindrical, cup-shaped, or massive, ellipsoidal. Surface both minutely and strongly hispid. Cortex 0·96 mm. in thickness, chiefly constituted of the sterrastral layer.

Spicules.—I. Megascleres. 1. *Somal oxea*, 3·57 by 0·058 mm. 2. *Cortical oxea.* 3. *Orthotriæne*, rhabdome 3·213 by 0·055 mm., cladi 0·36 mm. long. 4. *Protriæne*, rhabdome 3·57 mm. long, cladi 0·1 mm., chord 0·097 mm. long. 5. *Anatriæne*, rhabdome 4·81 mm. long, cladi 0·084 mm., chord 0·071 mm. long.

II. Microscleres. 6. *Sterraster*, spherical, 0·065 mm. in diameter. 7. *Somal pycnaster*, actines short, cylindrical, truncate, 0·01 mm. in diameter. 8. *Subcortical spheraster*, centrum fairly large, actines numerous, conical, minutely spined near the end, 0·032 mm. in diameter. 9. *Choanosomal oxyaster*, actines not numerous, conical, 0·04 mm. in diameter.

Colour.—Cream-yellow in the dried state.

Habitat.—The more or less cup-shaped specimen (pl. vii. figs. 1, 2, Bowerbank, vol. iii., *op. cit.*) is from the island of Fulah and Unst, in "deep water"; for the oval specimen (pl. vii. figs. 3, 4, Bowerbank, vol. iii., *op. cit.*) no locality is cited.

Remarks.—The measurements of spicules are taken from the original type figured by Bowerbank from the island of Fulah and Unst. It differs in some respects from the second (oval) specimen figured by Bowerbank, particularly in the absence of spherasters. The material at my disposal is, however, insufficient for the discussion of their identity.

In the type specimen a few small, apparently uniporal, oscular chones occur scattered in an ill-defined group in the interior of the cup.

Section 1. *Pantæosa.*

Species possessing both somal and cortical oxeas, and anatriænes or protriænes, or both, in addition to orthotriænes or dichotriænes.

Cydonium cooksoni, n. sp.

Sponge (?).—Cortex 0·415 mm. in thickness, ectochrote very thin. Pores in sieves overlying incurrent chones. Oscules (?). Surface hispidated by cortical oxeas and somal oxeas and protriænes, the last two protruded for a distance of 1·8 mm.

Spicules.—I. Megascleres. 1. *Somal oxea*, 1·83 by 0·041 mm. 2. *Cortical oxea*, 0·129 by 0·004 mm. 3. *Orthotriæne*, rhabdome 1·6 by 0·0645 mm., cladi 0·24 mm. long. 4. *Protriæne*, rhabdome fusiform, 2·38 by 0·075 mm. close to the cladal origin, and 0·0129 mm. where thickest.

II. Microscleres. 5. *Sterraster*, spherical, depressed, 0·0774 by 0·066 mm. 6. *Somal spheraster*, minute, centrum comparatively large, actines short, cylindrical, with rounded ends, 0·001 to 0·006 mm. in diameter. 7. *Subcortical spheraster*, centrum large, pro-

duced into numerous conical actines, 0·016 to 0·019 mm. in diameter. 8. *Choanosomal chiaster*, actines slender, cylindrical, truncate, 0·0197 mm. in diameter.

Habitat.—Charles Island, Galapagos (Commander W. E. Cookson). In British Museum collection, labelled *Stelletta* E. 14.

Cydonium berryi, n. sp.

Sponge.—Small, spherical, oscules not distinguishable from the pores; pores 0·032 to 0·045 mm. in diameter, in sieves overlying chones, which are about 0·16 mm. in diameter. Surface finely hispidated with cortical oxeas. Cortex 0·7 to 0·95 mm. in thickness, consisting chiefly of the sterrastral layer. Megascleres of the choanosome radiating from the centre to the cortex.

Spicules.—I. Megascleres. 1. *Somal oxea*, fusiform, sharply pointed, 2·54 by 0·026 mm. 2. *Ectosomal oxea*, fusiform, 0·31 by 0·008 mm. 3. *Orthotriæne*, rhabdome conical, attenuating to an exceedingly fine point, 3·5 by 0·0516 mm., cladi 0·175 mm., chord 0·318 mm. in length. 4. *Protriæne*, rhabdome fusiform, sharply pointed, 2·54 mm. long and over, by 0·0129 mm. just below the cladal origin, and 0·023 mm. where thickest; cladi 0·0516 mm. long. 5. *Anatriæne*, rhabdome conical, cylindrical, 0·258 mm. in diameter; cladi 0·084 mm., chord 0·1 mm., sagitta 0·065 mm. in length.

II. Microscleres. 6. *Sterraster*, ellipsoidal, actines with flattened polygonal ends, furnished with recurved spines, 0·071 by 0·065 mm. 7. *Ectosomal chiaster*, actines short, cylindrical, truncated at the ends, from about six to twenty in number, 0·008 mm. in diameter. 8. *Choanosomal chiaster*, similar but larger, 0·012 to 0·015 mm. in diameter. 9. *Subcortical spheraster*, small, centrum confluent with the actines, which are numerous, conical, and sharply pointed, 0·012 mm. in diameter.

Colour.—In the dried state, grey.

Habitat.—Lingin, China (Captain Berry, collection in British Museum, labelled 4, 27, 73).

Remarks.—The single specimen of this species is constricted in the middle, so as to appear like two spheres joined together. Minute anatriænes like those observed on *Cydonium gigas* were seen projecting from the surface, one which extended 0·16 mm. beyond the cortex gave the following measurements:—Rhabdome 0·002 mm. in diameter, cladi 0·008 long, chord 0·0095 mm. I dedicate the species to Captain Berry, who brought it home from China.

Cydonium japonicum, n. sp.

Sponge.—Large, cup-shaped, sessile, the inner surface even, the outer growing out into rounded lobes; both surfaces minutely hispidated by cortical oxeas. Incurrent and ex-

current chones similar, both provided with sieve-pores scattered over both inner and outer surfaces but absent from the margin of the cup. Cortex 0·8 mm. in thickness, composed almost entirely of the sterrastral layer.

Spicules.—I. Megascleres. 1. *Somal oxea*, fusiform, usually curved, sometimes irregularly, 2·7 by 0·032 mm. 2. *Cortical oxea*, small, fusiform. 3. *Orthotriæne*, rhabdome conical, 2·4 to 2·6 by 0·078 mm., cladi from 0·23 to 0·38 mm. long. 4. *Anatriæne*, rhabdome cylindrical, long, 0·018 mm. in diameter, cladi 0·1 mm., chord 0·0839 mm., sagitta 0·11 mm. long. This spicule is more than usually abundant.

II. Microscleres. 5. *Sterraster*, spherical or ellipsoidal, depressed, 0·0775 mm. in diameter, or 0·09 by 0·0775 by 0·058 mm. 6. *Somal spheraster*, minute, centrum forming the greater part of the spicule, the actines occurring as short irregular prominences, diameter 0·005 mm. 7. *Subcortical spheraster*, centrum large, actines conical, sharply pointed, numerous, diameter 0·02 mm. 8. *Choanosomal oxyaster*, centrum small or absent, actines not numerous, conical, smooth, 0·032 mm. in diameter.

Colour.—Cream-white. Size, 250 mm. by 334 mm. across the mouth of the cup.

Habitat.—Japan.

Remarks.—In general form this sponge much resembles *Synops neptuni* (p. 227), from which it is distinguished not only by the character of the oscules, but by the greater variety and larger size of its spicules. The sponges which it most nearly approaches in the characters of its spicules are *Geodia nodastrella*, Carter, and *Geodia carteri*; its general form distinguishes it from both, and from the latter it is also distinguished by the absence of a well-developed ectochrote.

Cydonium pleiades, n. sp.

Sponge.—(?).

Spicules.—I. Megascleres. 1. *Somal oxea*, fusiform, 3·4 by 0·06 mm. 2. *Cortical oxea*, about 0·25 by 0·0064 mm. 3. *Dichotriæne*, rhabdome 3·34 by 0·078 mm., cladi bent backwards at the point of first dichotomisation, subsequently dichotomising once, twice, or three times; in a thrice dichotomising example the protocladi measured 0·258 mm., deuterocladi 0·045 mm., tritocladi 0·026 mm. in length; in one dichotomising four times the protocladi measured 0·27 mm., deuterocladi 0·064 mm., tritocladi 0·064 mm., tetartocladi 0·0387 mm. in length. 4. *Anatriæne*, rhabdome 0·032 mm. in diameter, cladi 0·148 mm., chord 0·161 mm., sagitta 0·142 mm. in length.

II. Microscleres. 5. *Sterraster*, spherical, depressed, 0·09 by 0·071 mm. 6. *Somal spheraster*, minute, centrum comparatively large, actines short, cylindrical, truncate, 0·006 mm. in diameter. 7. *Subcortical spheraster*, centrum large, actines conical, almost sharply pointed but rounded off at the ends, 0·016 mm. in diameter. 8. *Choanosomal*

oxyaster, actines conical, oxeate, minutely roughened or spined, very variable in number and disposition, frequently reduced to one, with a second represented by a lateral terminal tylote, which is inclined to the axis of the actine so as to render the spicule retort-shaped; diactinate forms also common, the two actines sometimes making an angle of 60° with each other, with the outer margin well rounded about the angle, and the inner margin angular, a single actine 0·029 mm. in length.

Habitat.—East Africa; collection British Museum.

Remarks.—This species is distinguished by the characters of the choanosomal oxyaster, and the irregular repeated dichotomosis of the dichotriæne.

Cydonium depressum (Bowerbank).

Geodia depressa, Bowerbank, Proc. Zool. Soc. Lond., p. 5, pl. i. figs. 9–15, 1873.

Sponge.—Massive, sessile, surface even, minutely hispid; oscules congregated, resembling the pores; cortex 0·8 mm. in thickness, constituted chiefly of the sterrastral layer; ectochrote very thin, traversed by cortical oxeas.

Spicules.—I. Megascleres. 1. *Somal oxea*, 3·175 by 0·046 mm. (B.) to 4·28 by 0·06 mm. (S.). 2. *Cortical oxea.* 3. *Orthotriæne*, rhabdome 4·23 by 0·054 mm., chord 0·5 mm. (B.), and 4·0 by 0·097 mm. 4. *Anatriæne*, rhabdome 6·35 by 0·0127 mm. (B.), or by 0·0258 (S.), cladi 0·13 mm. long, chord 0·135 mm. (S.).

II. Microscleres. 5. *Sterraster*, spheroidal, 0·13 mm. (B.), 0·08 mm. (S.) in diameter. 6. *Somal spheraster*, 0·006 mm. in diameter. 7. *Choanosomal oxyaster*, actines not numerous, conical, 0·032 mm. in diameter.

Colour.—Cream-white in the dried state.

Habitat.—Dardanelles.

Remarks.—The letter (B.) after a measurement signifies that it was taken from Bowerbank's illustration, (S.) from type-slides in the British Museum.

The sponge is so similar to *Geodia gigas*, O. Schmidt, that I believe the two species will prove to be identical; but as I have only seen dried specimens of *Geodia depressa*, Bowerbank, I hesitate to suppress it.

Cydonium gigas (O. Schmidt).

Geodia gigas, O. Schmidt, Spong. Adriat. Meeres, p. 50, pl. iv. figs. 8, 9, 1862.

Sponge.—Spherical; surface finely hispid; oscules congregated; excurrent chones larger than the incurrent, but otherwise similar. Cortex 1 mm. thick; consisting of a well-developed ectochrote 0·13 mm. thick, traversed by very numerous hispidating oxeas

(No. 2) and occasional anatriænes; a sterrastral layer 0·8 mm. thick; and an inner fibrous layer 0·08 mm. thick.

Spicules.—I. Megascleres. 1. *Somal oxea*, 3·57 by 0·45 mm. (N.) and 3·2 by 0·055 mm. (H.). 2. *Cortical oxea*, 0·45 by 0·004 mm. (H.). 3. *Orthotriæne*, rhabdome 3·38 by 0·042 mm. (N.) and 3·14 by 0·067 mm., cladi 0·366 mm. long (H.). 4. *Protriæne*, rhabdome 0·006 mm. in diameter, cladi 0·1 mm. in length (N.), rhabdome 5·7 by 0·02 mm., cladi 0·118 mm. in length (H.). 5. *Anatriæne*, rhabdome 0·0194 mm. in diameter, cladi 0·1 mm., chord 0·13 mm. long (N.), rhabdome 6·6 by 0·0276 mm., cladi 0·126 mm., chord 0·13 mm., sagitta 0·13 mm. long (H.).

II. Microscleres. 6. *Sterraster*, spherical, 0·077 mm. (N.), 0·067 mm. (H.), in diameter. 7. *Somal chiaster*, actines short, cylindrical, truncate or tylote, 0·007 mm. in diameter. 8. *Choanosomal chiaster*, actines slender, conical, usually truncate, sometimes roughened near the ends, 0·04 mm. in diameter.

Colour.—Yellowish-grey.

Habitat.—Adriatic.

Remarks.—The letter (N.) indicates that the measurements were taken from a fragment of *Geodia gigas*, presented to Dr. Norman by O. Schmidt, (H.) from a whole specimen obtained by Professor Haddon from the Zoological Station, Naples. The two sets of measurements are fairly accordant.

Amongst the hispidating oxeas I observed some very slender anatriænes with minute cladomes, the chord not measuring above 0·007 mm. The appearance of these small spicules, where we usually meet with the most completely developed forms, was so unexpected that it naturally arrested attention and led to further investigation, which was rewarded by finding that the small cortical oxeas sometimes bear cladi like those of the anatriæne, and in one instance a typical fusiform oxea, only 0·394 by 0·004 mm. in size, was seen, bearing at its distal pointed end a true anatriæne cladome, with a chord only 0·004 mm. long. The resemblance of these minute anatriænes to the cladose tylostyles of *Proteleia sollasi*, Ridley and Dendy, is a very suggestive fact. Between the last named sponge and *Cydonium gigas* there can hardly be any close connection, and if we cannot regard the cladose spicules of either as directly descended from those of the other, we are led to conclude that we have here a new and striking case of homoplastic development. The hispidating oxeas share with the other spicules of the sponge a molecular structure which is similarly plastic to the influence of tangential strains in the ectosome, leading to a triradiate branching near the ends.

Section 2. *Dirabdosa.*

Species possessing both cortical and somal oxeas, but only one form of triæne, which is neither an anatriæne nor a protriæne.

Cydonium gibberosum (Bowerbank).

Geodia gibberosa, Bowerbank, Proc. Zool. Soc. Lond., p. 7, pl. i. figs. 16–22, 1873.
" " Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. ix. p. 362, 1882.

Carter considers that *Geodia tumulosa*, Bowerbank, which he obtained from Puerto Cabello in the Caracas, is conspecific with *Geodia cariboa*, Duch. and Mich., *Geodia gibberosa*, Lamarck, and *Geodia tuberculosa*, Bowerbank.

Cydonium inconspicuum (Bowerbank).

Pachymatisma inconspicua, Bowerbank, Proc. Zool. Soc. Lond., p. 326, pl. xxxi. figs. 1–6, 1873.

Sponge.—Massive, sessile; surface even, minutely hispidated; cortex 0·556 mm. in thickness, composed almost entirely of the sterrastral layer. Pores in sieves fringed with marginal oxeas, overlying incurrent chones; oscules not distinguishable from the pores.

Spicules.—I. Megascleres. 1. *Somal oxea*, 1·9 by 0·029 mm. 2. *Cortical oxea*, 0·39 mm. long (Bowerbank). 3. *Orthotriæne*, rhabdome 2·0 by 0·033 mm.

II. Microscleres. 4. *Sterraster*, spherical, depressed; 0·064 mm. in diameter. 5. *Somal spheraster*, centrum small, actines cylindrical, short, truncate, 0·0065 mm. in diameter. 6. *Choanosomal oxyaster*, centrum small, actions slender, about 0·020 mm. in diameter.

Colour.—Light fawn colour in the dried state. Size, 75 mm. long by 31 mm. and 19 mm.

Habitat.—South Seas.

Cydonium nux, Selenka.

Stelletta nux, Selenka, Zeitschr. f. wiss. Zool., Bd. xvii. p. 569, pl. xxxv. figs. 11–13, 1867.
Tethya nux, Ridley, Spong. "Alert," p. 472 (footnote), 1884.
Stellétta nux, Vosmaer, Bronn's Thierreich, Porifera, p. 319, 1887.

Sponge.—Spherical, surface covered with tubercles, spicules scarcely projecting beyond it. Cortex thick.

Spicules.—I. Megascleres. 1. *Strongyle*, fusiform, 1·83 by 0·0387 mm. 2. *Dichotriæne.*

II. Microscleres. 3. *Sterraster*, oval, 0·0774 by 0·09 mm. 4. *Spheraster*, centrum large, actines conical, smooth, oxeate, numerous; diameter 0·096 mm., of centrum 0·0516

mm. 5. *Chiaster*, centrum well developed, actines cylindrical, tylote, varying from about six to twelve in number, 0·016 mm. in diameter.

Colour.—Externally brown, yellowish within.

Habitat.—Samoa Islands.

Remarks.—I owe a type-slide containing mounted spicules of this sponge to the kindness of Dr. Perceval Wright, to whom it was presented by Selenka. The spicules evidently belong to a sponge closely related to *Cydonium eosaster*, Sollas, and *Cydonium globostelliferum* (Carter). The spheraster is, however, much larger than in either of these species, and the rhabdi are strongyles, not oxeas. The minute aster, which I have termed a chiaster, should perhaps in strictness be termed a spheraster with tylote actines.

Cydonium globostelliferum (Carter).

Geodia globostellifera, Carter, Ann. and Mag. Nat. Hist., ser. v. vol. vi. p. 134, pl. vi. fig. 38, 1880.

? Geodia globostellifera, Ridley, Spong. "Alert," p. 480, pl. xliii. fig. 6, 1884.

Sponge.—Globular, free or attached; surface covered with attached detritus.

Spicules.—I. Megascleres. 1. *Somal oxea*, 2·39 by 0·021 mm. (C.), 3·0 by 0·038 mm. (R.). 2. *Cortical oxea*, 0·16 by 0·005 mm. (R., not mentioned by Carter). 3. *Orthotriæne*, rhabdome 1·71 by 0·021 mm. (C.), by 0·07 mm. (R.); cladi, chord 0·5 mm. (C.), 0·58 mm. (R.). 4. *Protriæne*, cladi 0·112 mm. long (C.), 1 mm. (R.).

II. Microscleres. 5. *Sterraster*, 0·07 mm. (C.), 0·09 mm. (R.), in diameter. 6. *Spheraster*, 0·0211 mm. (C.), 0·028 mm. (R.), in diameter. 7. *Somal chiaster*, actines numerous, truncate, 0·0042 mm. (C.), 0·0063 mm. (R.), in diameter. 8. *Choanosomal chiaster*, 0·034 mm. (C.), 0·038 mm. (R.), in diameter.

Colour.—Violet-grey (C.), pale crimson in places (R.). Size, 19 mm. (C.), 80 mm. (R.), in diameter.

Habitat.—Gulf of Manaar (C.); Port Darwin, north-east coast of Australia, near tide marks, bottom, sand and rocks (R.).

Remarks.—The letters (C.) and (R.) placed after the measurements indicate that they are quoted from Carter and Ridley respectively. It will be seen that the two sets of measurements correspond fairly well, and probably the two sponges belong to the same species, as Ridley supposes; there still remain two points for further examination before this can be regarded as certain,—first the apparent absence of cortical oxeas in Carter's sponge, and next the small diameter of the orthotriænes as compared with that in Ridley's specimens.

The species is evidently very similar to *Cydonium eosaster*, in which, however, dichotriænes and not orthotriænes are present.

Section 3. *Ditriæna.*

Species without cortical oxeas, but with at least two forms of triæne.

Cydonium arabicum, Carter.

Geodia (Cydonium) arabica, Carter, Ann. and Mag. Nat. Hist. ser. 4, vol. iv. p. 4, pl. i. figs. 9–16, 1869.

Sponge.—Globular, free or fixed ; surface hispid.

Spicules.—I. Megascleres. 1. *Oxea*, 2·85 by 0·0552 mm. 2. *Orthotriæne*, rhabdome 3·88 by 0·0966 mm. 3. *Protriæne*, rhabdome 5·83 by 0·0414 mm. 4. *Anatriæne*, rhabdome 5·14 by 0·0277 mm.

II. Microscleres. 5. *Sterraster*, ellipsoidal, 0·11 by 0·096 by 0·069 mm. 6. *Spheraster*, with slender, cylindrical, truncate actines, 0·025 mm. in diameter. 7. *Spheraster*, with conical actines, having rounded ends, 0·046 mm. in diameter.

Colour.—Grey externally, yellowish within. Size, 75 mm. in diameter.

Habitat.—South-east Arabia, north-east end of the island Masjie.

Cydonium (?) pergamentaceum (O. Schmidt).

Geodia pergamentacea, O. Schmidt, Spong. Atlant. Gebiet., p. 69, 1870.

Sponge.—Parchment-like, hispid in places, cortex 0·25 mm. in thickness (O. Schmidt).

Spicules.—I. Megascleres. 1. *Oxea*, 2·24 by 0·038 mm. 2. *Orthotriæne*, rhabdome 1·6 by 0·032 mm., chord 0·533 mm. 3. *Anatriæne*, rhabdome 1·78 by 0·013 mm., chord 0·088 mm.

II. Microscleres. 4. *Sterraster*, ellipsoidal, 0·076 by 0·06 mm. 5. Other *Asters* (?).

Habitat.—Portugal.

Remarks.—The measurements were obtained from a type-slide presented by Schmidt to the British Museum. Schmidt's description is just two lines in length.

Cydonium conchilegum (O. Schmidt).

Geodia conchilega, O. Schmidt, Spong. Adriat. Meeres, p. 51, pl. iv. fig. 11, 1862.

Sponge.—Irregularly tuberose ; surface hispid in places, bearing attached fragments of shells and stones ; cortex 1·79 mm. in thickness, chiefly composed of the sterrastral layer, ectochrote very thin. Pores in sieves overlying large incurrent chones ; oscules not distinguishable from the pores.

Spicules.—Megascleres. 1. *Oxea*, 2·32 by 0·032 mm. 2. *Dichotriæne*, rhabdome 2·2 by 0·032 mm., protocladi 0·052 mm., deuterocladi 0·135 mm. long. 3. *Anatriæne*, rhabdome 3·93 by 0·013 mm., cladi 0·064 mm. long, chord 0·1 mm.

II. Microscleres. 4. *Sterraster*, ellipsoidal, with three unequal axes, 0·09, 0·116, and 0·142 mm. in length respectively. 5. *Somal spheraster*, minute, centrum comparatively large, actines short, cylindrical, truncate, from 0·004 to 0·007 mm. in diameter. 6. *Subcortical spheraster*, centrum large, actines numerous, cylindrical, minutely spined, especially towards the ends, 0·0276 mm. in diameter. 7. *Choanosomal chiaster*, centrum small, actines slender, cylindrical, tylote; 0·0236 mm. in diameter.

Colour.—(?).

Habitat.—Zlarin, Adriatic.

Remarks.—The choanosome is crowded with foreign bodies, grains of sand, and the like; and beneath the outer epithelium of the cortex the empty tests of Diatoms are accumulated as if to serve a skeletal purpose. The measurements given above were obtained from a part of one of Schmidt's types presented to me by Professor von Graff.

Cydonium tuberosum (O. Schmidt).

Geodia tuberosa, O. Schmidt, Spong. Adriat. Meeres, p. 50, pl. iv. fig. 10, 1862.

Sponge.—Irregularly tuberous; surface finely hispid, with projecting megascleres; cortex 1·143 mm. in thickness, ectochrote very thin. Pores in sieves overlying incurrent chones.

Spicules.—I. Megascleres. 1. *Oxea*, 3·93 by 0·05 mm. 2. *Orthotriæne*, rhabdome 3·6 by 0·075 mm., cladi 0·31 mm. long. 3. *Anatriæne*, rhabdome 3·6 by 0·023 mm., probably also longer, cladi 0·1 mm., chord 0·1 mm. long.

II. Microscleres. 4. *Sterraster*, spherical, depressed, 0·09 mm. in diameter. 5. *Somal pycnaster*, actines cylindrical with truncate ends, 0·012 mm. in diameter. 6. *Choanosomal oxyaster*, actines conical, slender, roughened, variable in number, 0·023 mm. in diameter. 7. *Subcortical spheraster*, actines conical, minutely spined; diameter 0·02 mm.

Colour.—Chalk-white in the dried state.

Habitat.—Zlarin, Adriatic.

Remarks.—The measurements were taken from a fragment of one of Schmidt's types sent me by Professor von Graff.

Cydonium normani, n. sp.

Sponge.—Large, ellipsoidal; surface thickly hirsute, owing to the projection of long spicules for about 25 mm. beyond it. Chones covered by sieve-like roofs. Oscules not distinguishable from the pores. Cortex consisting chiefly of the sterrastral layer,

without a distinct ectochrote, 1·6 mm. in thickness, growing out in one or two places into low papillary or ridge-like processes.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, sharply pointed, 6·1 mm. and over by 0·064 mm. 2. *Orthotriæne*, rhabdome conical, attenuating to a sharp point, 7·15 by 0·11 mm., cladi 1 mm. long. 3. *Protriæne*, rhabdome 11·78 by 0·079 mm., cladome terminal or subterminal, in the latter case the cladal origin is situated 0·28 from the end of the ectactine, cladi 0·25 mm. in length. 4. *Anatriæne*, rhabdome 22·5 mm. and over by 0·04 mm., cladome nearly terminal, cladal centre usually about 0·008 mm. from the end of the ectactine, which forms a slight rounded projection in the front curve of the cladome; cladi 0·18 mm., chord 0·16 mm., sagitta 0·15 mm. long, sometimes the chord is wider, 0·20 mm. long.

II. Microscleres. 5. *Sterraster*, large, spherical, depressed, ends of the actines polygonal, 0·004 mm., bearing five to six recurved spines at the edges, diameter 0·32 mm. 6. *Somal spheraster*, a well-marked centrum and numerous conical, sharply pointed, or bacillary, strongylate actines; diameter 0·012 mm. 7. *Choanosomal oxyaster*, no distinct centrum; actines long, conical, roughened or smooth, sharply pointed; diameter 0·04 mm.

Colour.—Reddish-brown. Size, 135 mm. by 122 mm. by 100 mm.

Habitat.—Vigten Island, Norway (Norman).

Section 4. *Monotriæna.*

Species possessing but one form of oxea and but one form of triæne.

Both species included in this section are insufficiently characterised.

Cydonium simplex (O. Schmidt).

Geodia simplex, O. Schmidt, Spong. Atlant. Gebiet., p. 70, 1870.

Sponge.—"A fragment, differing only in the simplicity of the spicules from *Geodia* (*Cydonium*) *gigas*" (O. Sch.).

Spicules.—I. Megascleres. 1. *Oxea*, 2·5 by 0·038 mm. 2. *Orthotriæne*, rhabdome 1·85 by 0·032 mm., chord 0·426 mm.

II. Microscleres. 3. *Sterraster*, 0·07 mm. in diameter. 4. *Aster*, 0·02 mm. in diameter.

Habitat.—Greenland.

Remarks.—The measurements of spicules were obtained from a type-slide in the British Museum.

Cydonium (?) *geodinum* (O. Schmidt).

Stelletta geodina, O. Schmidt, Spong. Algier., p. 20, pl. iv. fig. 5, 1868.

Sponge.—(?). Cortex thin.

Spicules.—I. Megascleres. 1. *Oxea*, 2·755 by 0·022 mm. 2. *Orthotriæne*, 1·42 mm. long, cladi 0·34 mm. long.

II. Microscleres. 3. *Sterraster*, spherical, 0·041 mm. in diameter (O. S.). 4. *Choanosomal oxyaster*, 0·056 mm. in diameter (O. S.). 5. *Somal spheraster*, 0·015 mm. in diameter (O. S.).

Habitat.—Algiers.

Remarks.—The measurements were obtained from a type-slide in the British Museum except those marked (O. S.), which are from Schmidt's descriptions. The sponge evidently belongs to the Geodiidæ, but may possibly have to be placed in a new genus.

Genus *Synops*, Vosmaer.

Section *Pantæosa*.

Synops macandrewii (Bowerbank).

Geodia macandrewii, Bowerbank, Proc. Zool. Soc. Lond., p. 196, pl. x., 1872.

Sponge.—Massive, sessile; surface even; hispidated or hirsute with somal and cortical oxeas, dichotriænes and protriænes; cortex, 3·26 mm. in thickness, chiefly constituted of the sterrastral layer; ectochrote and inner fibrous layer both very thin. Pores, from 0·05 to 0·238 mm. in diameter, in sieves overlying incurrent chones, 0·636 mm. in diameter; oscules small, 0·556 mm. in diameter, surrounded by a membranous margin, fringed with cortical oxeas, leading into small excurrent chones.

Spicules.—I. Megascleres. 1. *Somal oxea.* 2. *Cortical oxea*, 0·35 mm. long. 3. *Dichotriæne*, rhabdome 7·3 by 0·11 mm., protocladi 0·5 mm., deuterocladi 0·32 mm. long. Cladome depressed or cyathiform. 4. *Protriæne*, rhabdome fusiform, long, 0·0377 mm. in diameter; cladome subterminal, cladal centre situated 0·175 mm. from its oxeate distal termination, which sometimes bears a second cladome; cladi 0·1675 mm. long. 5. *Anatriæne*, rhabdome 8·92 mm. and over in length; cladi 0·18 mm., chord 0·1675 mm. long.

II. Microscleres. 6. *Sterraster*, depressed, spherical, 0·27 mm. in diameter. 7. *Somal spheraster*, 0·0065 mm. in diameter. 8. *Choanosomal spheraster*, with a comparatively large centrum and long conical actines, 0·025 mm. in diameter.

Colour.—A deep cream-yellow. Size, 263 mm. long by 225 mm. wide by 137 mm. high.

Habitat.—Vigten Island, Norway; depth, 100 fathoms (Rev. Dr. Norman's collection).

Section *Monotriæna.*

Synops (?) *media*, Bowerbank.

Geodia media, Bowerbank, Proc. Zool. Soc. Lond., p. 13, pl. ii. figs. 24–29, 1873.

Sponge.—Massive, sessile; oscules comparatively large; cortex 0·56 mm. in thickness, composed chiefly of sterrasters; ectochrote thin, containing minute asters (No. 5).

Spicules.—I. Megascleres. 1. *Oxea*, 1·51 by 0·032 mm. 2. *Plagiotriæne*, rhabdome 1·12 by 0·45 mm., cladi 0·254 mm. long, chord 0·32 mm.

II. Microscleres. 3. *Sterraster*, ellipsoidal, 0·11 by 0·088 mm. 4. *Somal spheraster*, minute, with truncated cylindrical actines, 0·006 mm. in diameter. 5. *Choanosomal oxyaster*, 0·026 mm. in diameter.

Colour.—Pale buff-yellow in the dried state. Size, about 20 by 30 mm.

Habitat.—Mexico.

Remarks.—The presence of large, simple, congregated oscules distinct from the pores leads us to assign this species to *Synops*. The measurements of the spicules were made from type-slides in the British Museum.

Synops pyriformis, Vosmaer.

Synops pyriformis, Vosmaer, Spong. "Willem Barents," p. 20, pl. iii. figs. 52–63; pl. iv. figs. 119, 154, 1882.

Sponge.—Pyriform, small roots proceeding from the base; oscules confined to a depression on the summit; surface strongly hispid by the projection of the radial oxeas. Cortex 1·25 to 1·5 mm. thick, ectochrote reduced to a single layer of subepithelial spherasters.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, often becoming strongylate, 6·6 by 0·08 mm. 2. *Orthotriæne*, 5·4 by 0·09 mm., chord 1·43 mm.

II. Microscleres. 3. *Sterraster*, ellipsoidal, about 0·13 by 0·10 mm. 4. *Somal spheraster*, with a well-developed centrum produced into numerous conical, sharply pointed actines, 0·016 mm. in diameter. 5. *Choanosomal oxyaster*, actines stout, conical; 0·07 mm. in diameter.

Colour.—Pale ochreous to faintly pink. Size, 120 mm. in height by 100 mm. in maximum diameter.

Habitat.—Lat. 71° 12′ N., long. 20° 30′ E.; near Hammerfest; depth, 135 fathoms.

Remarks.—This is a very distinct species of *Synops*, characterised by more than usually large megascleres. As in all other species of the genus anatriænes are absent, or if present so remarkably rare that they may be disregarded. I saw one or two cladal ends of these spicules in the choanosome, they were evidently foreign to the sponge and had been incorporated; possibly the presence of those mentioned by Vosmaer is to be similarly explained. The chamber system, of which Vosmaer professed to be unable to make out all the details, is precisely similar in all respects to that of other members of the genus; this and the dimensions of the spicules I was able to ascertain by examination of a fine specimen which I owe to the kindness of its describer.

Genus *Isops*, Sollas.

Section *Ditriæna*.

Isops phlegræi, Sollas.

Isops phlegræi, Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 396, pl. xvii.

Sponge.—More or less spherical; surface hispidated by projecting megascleres. Cortex about 0·64 mm. in thickness, consisting chiefly of the sterrastral layer, both the inner fibrous layer and the ectochrote being very thin, the latter containing a layer of somal spheraster. Oscules and pores similar, small.

Spicules.—I. Megascleres. 1. *Oxea*, 6 by 0·063 mm. 2. *Plagiotriæne*, rhabdome 4 by 0·425 mm., cladi 0·6 mm. in length; sometimes becoming dichocladose. 3. *Protriæne*, rhabdome long, 0·02 mm. in diameter. 4. *Anatriæne*, rhabdome similar.

II. Microscleres. 5. *Sterraster*, ellipsoidal, 0·09 mm. in diameter. 6. *Somal spheraster*, centrum comparatively small, actines conical, oxeate numerous, diameter 0·012 mm. 7. *Choanosomal spheraster*, centrum comparatively small, actines long, conical, oxeate, somewhat numerous, from 0·02 to 0·07 mm. in diameter.

Colour.—Faint grey. Size, 25 mm.

Habitat.—Kors Fjord, Norway (Norman); depth, 180 fathoms.

Isops phlegræi, Sollas (?).

Isops pallida, Vosmaer, *tom. cit.*, p. 16, pl. i. figs. 9, 15; pl. ii. figs. 22–26, 29–38; pl. iv. fig. 117, 1882.

Sponge.—Ellipsoidal or pyriform, the basal part bears small papillary processes (traces of roots, Vosmaer).

Spicules.—I. Megascleres. 1. *Oxea.* 2. *Tylotoxea.* 3. *Orthotriæne.* 4. *Dichotriæne.* 5. *Anatriæne.*

II. Microscleres. 6. *Sterraster*. 7. *Oxyaster*, rays minutely spined. 8. *Spheraster*.

Colour.—Faint yellow.

Habitat.—Lat. 71° 12′ N., long. 20° 31′ E.; near Hammerfest; depth, 135 fathoms.

Isops phlegræi, Sollas (?).

Isops sphæroides, Vosmaer, Spong. "Willem Barents," p. 13, pl. i. figs. 10, 11, pl. ii. figs. 27, 28, 39–49; pl. iv. fig. 116, 1882.

Sponge.—Spherical; surface hispid; cortex thick.

Spicules.—I. Megascleres. 1. *Oxea*. 2. *Dichotriæne* and *Orthotriæne*. 3. *Anatriæne*.

II. Microscleres. 4. *Sterraster*. 5. *Oxyaster*. 6. *Spheraster*.

Colour.—Pale yellowish tint.

Habitat.—Lat. 71° 12′ N., long. 20° 30 E.; near Hammerfest; depth, 135 fathoms.

Isops globa (O. Schmidt).

Geodia globus, O. Schmidt, Spong. Atlant. Gebiet., p. 69, 1870.
Isops globa, Vosmaer, Spong. "Willem Barents," p. 18, 1882.

Sponge.—Spherical; up to 15 mm. in diameter. Cortex 0·3 to 1 mm. in thickness.

Spicules.—I. Megascleres. 1. *Oxea*, 4·1 by 0·038 mm. 2. *Dichotriæne*, protocladi 0·178 mm., deuterocladi 0·35 mm. long. 3. *Anatriæne*, chord 0·142 mm.

II. Microscleres. 4. *Sterraster*, 0·082 mm. in diameter. 5. *Aster*, 0·057 in diameter.

Habitat.—Portugal.

Remarks.—Schmidt's description is inadequate. The measurements of spicules were obtained from a type-slide in the British Museum. Schmidt makes mention of the presence of tylostyles with long tylotes; these are probably foreign to the sponge.

Section *Monotriæna*.

Isops (?) *apiarium*, O. Schmidt.

Caminus apiarium, O. Schmidt, Spong. Atlant. Gebiet., p. 71, pl. vi. fig. 14, 1870.

Sponge.—Cylindrical, rounded above, beehive-like. Oscules eight to ten in number, each situated on the summit of a little papilla-like elevation. Cortex 1 mm. in thickness, chiefly composed of the sterrastral layer.

Spicules.—I. Megascleres. 1. *Strongyle*, cylindrical, 1·42 by 0·316 mm. 2. *Triænes* (?).

II. Microscleres. 3. *Sterraster*, spherical, 0·213 mm. in diameter. 4. *Oxyaster*, with few remarkably slender actines.

Colour.—(?).

Habitat.—Florida ; depth, 153 fathoms.

Remarks.—The description has been chiefly taken from Schmidt's account. The measurements of spicules are from a type-slide in the British Museum. Schmidt makes no mention of triænes, but that is no reason for inferring they are not present. The sponge may represent a new genus, but it can hardly be assigned to *Caminus*.

Isops imperfecta (Bowerbank).

Geodia imperfecta, Bowerbank, Proc. Zool. Soc. Lond., p. 299, pl. xlvi. figs. 6–13, 1874.

Sponge.—Massive, tuberous, sessile ; surface smooth ; oscules scattered, small, circular. Ectochrote characterised by peculiar spherasters (No. 4). Cortex 1·43 mm. in thickness.

Spicules.—I. Megascleres. 1. *Oxea*, fusiform, bluntly pointed, often strongylate ; 1·75 by 0·039 mm. 2. *Orthotriæne*, cladi usually strongylate, frequently reduced to two or one in number.

II. Microscleres. 3. *Sterraster*, ellipsoidal, depressed, or more or less cylindrical, with rounded ends, 0·11 by 0·08 mm. 4. *Ectochrotal spheraster*, centrum well developed, actines short, cylindrical, divided into numerous spines at the ends ; 0·012 to 0·019 mm. in diameter. 5. *Somal spheraster*, centrum small ; actines slender, cylindrical, truncate, proceeding from the centrum abruptly ; 0·021 mm. in diameter.

Colour.—Cream-white in the dry state. Size, the largest of four specimens, 50 mm. long by 35 mm. broad.

Habitat.—South Sea ; growing on *Oculina rosea*, obtained from a dealer.

Isops dysoni (Bowerbank).

Geodia dysoni, Bowerbank, Proc. Zool. Soc. Lond., p. 14, pl. iii. figs. 1–5, 1873.

Sponge.—Massive, sessile (?). Surface smooth, uneven ; cortex about 1 mm. in thickness, chiefly composed of the sterrastral layer.

Spicules.—I. Megascleres. 1. *Oxea*, 1·75 by 0·026 mm. 2. *Orthotriæne*, rhabdome 1·6 by 0·032 mm., cladi 0·35 mm. in length.

II. Megascleres. 3. *Sterraster*, spherical, depressed, 0·095 mm. in diameter. 4. *Somal aster* (?). 5. *Choanosomal chiaster*, actines slender, cylindrical, truncate ; 0·024 mm. in diameter.

Colour.—Cream-white in the dried state. Size, 75 mm. by 40 mm. (Bowerbank).

Habitat.—Honduras.

Remarks.—The measurements were obtained from type-slides in the British Museum. The specimen is much worn.

Isops (*?*) *parasitica* (Bowerbank).

Geodia parasitica, Bowerbank, Proc. Zool. Soc. Lond., p. 328, pl. xxxi. figs. 12–15, 1873.

Sponge.—Sessile, coating; surface even or slightly nodose, smooth.

Spicules.—I. Megascleres. 1. *Oxea*, 1·6 by 0·032 mm. (S.) to 1·85 by 0·045 mm. (B.). 2. *Orthotriæne*, rhabdome 1·22 mm. long, cladi 0·31 mm. long (B.).

II. Microscleres. 3. *Sterraster*, 0·08 mm. (S.) and 0·075 mm. in diameter (B.). 4. *Spheraster*, centrum large, actines conical, numerous; centrum 0·0105 mm. in diameter; total diameter 0·0169 mm. (B.). 5. *Orthodragma*, 0·08 mm. long (S.).

Colour.—Light cream-yellow in the dried state. Size, 6·1 mm. in thickness.

Habitat.—Unknown.

Remarks.—This species is founded on a fragment of a sponge, too incomplete for generic identification. The letter (B.) after the measurements of spicules indicates that they were obtained from Bowerbank's description or figures, (S.) from measurements made by me on the type-slide in the British Museum.

Isops inequalis (Bowerbank).

Geodia inequalis, Bowerbank, Proc. Zool. Soc. Lond., p. 12, pl. ii. figs. 18–23, 1873.

Sponge.—Irregularly massive, sessile.

Spicules.—I. Megascleres. 1. *Strongyle*, 1·837 mm. long. 2. *Orthotriæne*, rhabdome 1·97 mm. long, cladi 0·127 mm. long.

II. Microscleres. 3. *Sterraster*, oval. 4. *Somal* (*?*) *chiaster*, actines short, cylindrical, truncate, 0·0027 to 0·0056 mm. in diameter. 5. *Subcortical* (*?*) *spheraster*, actines conical, oxeate, numerous, 0·032 mm. in diameter. 6. *Choanosomal* (*?*) *oxyaster*, actines large, conical, 0·03 to 0·038 mm. in diameter.

Colour.—Cream-white in its dried state. Size, 45 mm. in height by 35 mm. at the base and 19 mm. at the summit.

Habitat.—Unknown.

Remarks.—All the measurements given above were obtained from Bowerbank's figures and description. The single specimen which Bowerbank had under description is so much worn that it is impossible to be sure of its generic position. Circular holes are scattered all over the surface, and it is on the presumption that these were not covered with sieve-pores that the sponge has been assigned to *Isops*.

Isops contorta (Bowerbank).

Pachymatisma contorta, Bowerbank, Proc. Zool. Soc. Lond., p. 327, pl. xxxi. figs. 7–11, 1873.

Sponge.—Branching; branches irregular, short, stout, anastomosing; surface undulating; oscules small, scattered; cortex 1·2 mm. thick.

Spicules.—I. Megascleres. 1. *Oxea*, 1·838 by 0·035 mm., sometimes passing into a strongyloxea. 2. *Orthotriæne*, rare and variable in dimensions.

II. Microscleres. 3. *Sterraster*, obtusely oval, depressed, 0·16 mm. in diameter. 4. *Somal spheraster*, 0·01 mm. in diameter. 5. *Choanosomal oxyaster*, 0·032 mm. in diameter.

Colour.—Light brown in the dried state.

Habitat.—Fiji Islands.

Remarks.—Measurements were taken from a type-slide in the British Museum. The characteristic microstrongyles of *Pachymatisma* are absent in this species.

Family II. Placospongidæ (Gray).

Sterrastrosa not possessing triæne spicules; the only megascleres are tylostyles. The sterrastral layer of the cortex is subdivided into irregular or polygonal plates, which are connected together by fibrous tissue.

Genus 1. *Placospongia*, Gray.

Placospongia melobesioides, Gray.

Placospongia melobesioides, Gray, Proc. Zool. Soc. Lond., pp. 127–129, woodcut, figs. 1–4, 1867.
? „ „ Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. pp. 53–55, 1880; vol. ix. p. 357, pl. xii. fig. 33, 1882.
? „ „ O. Sch., Spong. Atlant. Gebiet., p. 72, pl. vi. figs. 15–17, 1870.

Sponge.—Branching; branches angular, axis occupied by a dense accumulation of sterrasters. Surface even, smooth. Oscules (?).

Spicules.—I. Megasclere. 1. *Tylostyle*, actine cylindro-conic, strongylate, 1·03 by 0·014 mm., tylus 0·0178 mm. in diameter.

II. Microscleres. 2. *Sterraster*, ellipsoidal, 0·071 by 0·058 mm. to 0·067 by 0·063 mm. 3. *Spheraster*, centrum large, forming the greater part of the spicule, ends of the actines forming short tent-like spines upon it, 0·0129 mm. in diameter. 4. *Microstrongyle*, cylindrical, entirely spined; spines short, of unequal lengths, cylindrical, rounded at the ends, 0·24 by 0·008 mm. 5. *Spherules*, minute, 0·0012 mm. in diameter.

Colour.—Purplish-red, or white.
Habitat.—Borneo (Gray); Gulf of Manaar (Carter).

Remarks.—O. Schmidt describes sponges, which he refers to this species, from Florida, on coral reefs, at 30 to 60 fathoms. Type-slides are in the British Museum; these and the general structure of the sponge, as figured by Schmidt, show that if not identical, it is a very closely allied form; still I could not find the minute spherules so characteristic of the species, and it is possible that Schmidt's sponge should be referred to the new species, *Placospongia intermedia* (*vide* p. 273).

Carter's illustrations of the spicules of *Placospongia melobesioides* do not appear to be taken from new material, but from Gray's sponge; amongst them, however, is one of a small spiraster which I have not been able to find.

Placospongia carinata (Bowerbank) (Pl. XL. fig. 7).

Geodia carinata, Bowerbank, sp. MS., Phil. Trans. Roy. Soc., pp. 308, 314, pl. xxvi. fig. 10; pl. xxv. fig. 19, 1858.
" " Bowerbank, Mon. Brit. Spong., vol. i. p. 254, pl. x. fig. 163, 1864.
" " Bowerbank, Proc. Zool. Soc. Lond., p. 298, pl. xlvi. figs. 1–5, 1874.
" " Bowerbank, Proc. Zool. Soc. Lond., p. 295, 1875.
Placospongia carinata, Ridley, Spong. "Alert," p. 481, 1884.

Sponge.—Sessile, coating stems of *Gorgonia* or *Fuci* (Bowerbank), or massive branched. Surface smooth, with numerous longitudinal carinæ. Oscules simple, few, dispersed. Cortex 0·56 mm. in thickness, consisting chiefly of the sterrastral layer; beneath the external epithelium a layer of microstrongyles. The cortex is divided into plate-like pieces, having the edges bevelled on the inside, separated by longitudinal grooves, and united by transverse muscular masses, which are attached to the bevelled edges. The pores are probably situated in the grooves, and lead into canals which run radially through the muscular bands into the choanosome. The walls of the canals are lined by longitudinally disposed microstrongyles.

In the centre of the choanosome is a dense sterrastral axis, and numerous sterrasters are also scattered through the tissues between the axis and the cortex. The tylostyles are arranged side by side, with the strongylate ends diverted outwards in dense spicular bundles, which radiate from the sterrastral axis and towards the bevelled margins of the cortical plates and the sides of the poral grooves. Some of the spicules of these bundles traverse the muscular bands, and project on each side of the poral grooves.

Large spirasters (No. 3) occur within the choanosome, chiefly in the muscular tissue.

Spicules.—I. Megasclere. 1. *Tylostyle*, actine cylindroconic, usually strongylate,

but sometimes tornote or oxeate, 1·0 by 0·013 mm.; tylus spherical or ellipsoidal, 0·016 mm. in diameter.

II. Microsclere. 2. *Sterraster*, ellipsoidal or reniform, 0·097 by 0·0774 mm. 3. *Choanosomal spiraster*, centrum elongate, more or less cylindrical; actines not numerous, usually from six to eight, more or less conical, bent, subdivided near the end into simple or bifid cladi; arranged spirally, but sometimes collected into a whorl at each end of the centrum, 0·039 mm. in length. 4. *Microstrongyle*, straight, cylindrical, entirely spined, spines usually short, rounded at the ends; 0·0258 by 0·0064 to 0·008 mm. 5. *Somal microstrongyle*, minute, cylindrical, sinuous, smooth or sparsely spined, 0·019 by 0·019 by 0·0039 mm.

Colours.—Light fawn-yellow (dried); light chocolate-brown (in spirits).

Habitat.—South Seas (Bowerbank); Straits of Malacca (Bowerbank). Prince of Wales Channel, Torres Strait; depth, 7 fathoms; bottom, sand (Ridley, "Alert").

Placospongia intermedia, n. sp.

Sponge.—Small, incrusting (grown upon a *Vermetus*); surface raised where the cortical plates meet, into square ridges, giving it a low, "cloisonné" appearance. Oscules and pores (?).

Spicules.—I. Megasclere. 1. *Tylostyle*, 0·47 by 0·008 mm.

II. Microscleres. 2. *Sterraster*, ellipsoidal 0·0645 by 0·058 mm. 3. *Spheraster*, a spherical centrum covered with small tent-like spines, 0·02 mm. in diameter. 4. *Microstrongyle*, cylindrical, straight or sinuous, smooth or spined, from about 0·0118 to 0·0157 mm. in length, very variable in thickness, on an average about 0·0035 mm. or less. When spined this spicule becomes a spiraster.

Colour.—Chocolate-brown.

Habitat.—Punta Arenas; Central America; (?) Florida, Gulf of Mexico (O. Schmidt).

Remarks.—This species is distinguished from *Placospongia carinata* by the presence of the spheraster, and by the absence of the remarkable choanosomal spiraster which characterises the latter species. It differs from *Placospongia melobesioides* by the absence of spherules and the presence of the minute microstrongyles which replace them. The spicules included under the designation microstrongyles present a remarkable mixture of forms, including spirasters, spirulas, spherules, and microstrongyles in the restricted sense. A few spirasters of different character to the rest are also present, they are distinguished by a short thick spire and large conical spines.

The spheraster is traceable down to a minute sphere, 0·0039 mm. in diameter, with a roughened surface; as it is never clearly actinate, it is possible that it should be regarded as a spined sphere, rather than a spheraster.

The specimen on which the species is founded is in the British Museum collection. It much resembles in general appearance the specimen figured by Schmidt,[1] and, as already suggested, it is possible that Schmidt's sponge is identical with *Placospongia intermedia*.

Incertæ sedis.

Antares,[2] n. gen.

Sterrastrosa in which the megascleres are oxeas and tylotes, the microsclere a disciform sterraster.

Antares euastrum (O. Schmidt).

Stellettinopsis euastrum, O. Schmidt, Spong. Meerb. v. Mexico, p. 76, 1880.

Sponge.—"A fragment of a white branch 20 mm. long, of the thickness of a quill."
Spicules.—I. Megascleres. 1. *Oxea*, fusiform. 2. *Tylote*.
II. Microscleres. 3. *Sterraster*, disciform. Other asters absent.
Habitat.—Grenada, West Indies; depth, 170 fathoms.

Remarks.—As I have not seen this sponge I can only give Schmidt's description; imperfect as this is, it is sufficient, if correct, to show that the sponge is not a *Stellettinopsis*. Since the sterraster is disciform, and the cortex does not appear to be subdivided into plates, it is probably more nearly related to *Erylus* than to *Placospongia*; further it is possible that triænes and asters are present, but that Schmidt overlooked them, and in this case its alliance with *Erylus* would be very close. In any case the association of a tylote with a sterraster seems to involve the creation of a new genus.

Suborder III. MICROSCLEROPHORA.

Choristida in which megascleres are absent; the characteristic microscleres are either tetractinose asters, candelabra, or minute triænes.

Family III. Thrombidæ.

Microsclerosa with trichotriænes, and sometimes a peculiar form of amphiaster. The ectosome is thin and not sharply defined from the choanosome. The mesoderm is a dense collenchyma, containing numerous large granular cells in addition to collencytes. The canal system is diplodal.

[1] Pl. vi. fig. 15, Spong. Atlant. Gebiet., *Placospongia melobesioides*, O. Schmidt.
[2] Antares, the name of a star.

Genus 1. *Thrombus*,[1] n. gen.

With the characters of the family.

Thrombus challengeri, Sollas (Pl. VIII. figs. 24–39).

Thrombus challengeri, Sollas, Prelim. Account, Sci. Proc. Roy. Dubl. Soc., vol. v. p. 179, 1886.
? Corticium kittoni, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xiv. p. 24, 1874.

Sponge (Pl. VIII. fig. 24).—An amorphous fleshy mass, incrusting a species of *Rhizochalina*, and containing, embedded in its substance, numerous little spiral shells. Oscules and pores not seen. Surface irregular, the embedded shells everywhere protruding from it, smooth between the shells; viewed with a lens finely granulated by the projection of the cladi of the underlying trichotriænes.

Spicules.—The only spicules present are triænes, of which there are several varieties, all modifications of one prevailing form.

1. *Plagiotriæne* (Pl. VIII. figs. 25, 26), rhabdome straight, almost cylindrical, esactine tapering but slightly to a strongylate termination; ecactine dividing into three simple cladi, which are strongylate and but slightly tapering, curved somewhat sigmately, and directed at first more forwards than outwards, and finally more outwards than forwards. The spicule is minutely spined all over, except near the origin of the actines and cladi; the spines are erect, conical, sharply pointed, and spreading at the base tent-like. Rhabdome 0·1 by 0·0118 mm., cladi 0·055 by 0·0118 mm.; one or two cladi of this spicule are occasionally absent (Pl. VIII. fig. 29).

2. *Dichotriæne* (Pl. VIII. figs. 27, 28), one, two, or all three cladi may bifurcate; the dichotriænes are usually smaller than the plagiotriænes. Rhabdome 0·075 by 0·0118 mm., protocladi 0·0197, deuterocladi 0·0158 mm. long.

3. *Trichotriæne* (Pl. VIII. fig. 30), one, two, or all three cladi may be trifurcate, the middle deuterocladus continuing the direction of the protocladus. When only one or two of the cladi are trifurcate, the remainder may be either simple or bifurcate, or one simple and the other bifurcate. Sometimes one or two cladi are suppressed (Pl. VIII. fig. 31). Rhabdome 0·055 mm. in length, the proto- and middle deuterocladus together 0·0355 mm. in length, the deuterocladi 0·0158 mm.

The spicules are scattered isolately and without order in the choanosome; in the ectosome, however, they are directed with the rhabdome pointing away from the surface at right angles to it, and the cladi extending tangentially beneath it. The cladome is thus, as is the case with all true triænes, distally situated with respect to the actinal centre. Frequently the cladome may be seen projecting beyond the outer surface of the sponge, as though the spicule were in process of being extruded.

Colour.—A somewhat dark slate-grey.

[1] θρόμβος, ὁ, a lump or clot.

Habitat.—Station 177, August 18, 1874; lat. 16° 45′ S., long. 168° 7′ W.; off Api, New Hebrides; depth, 130 fathoms; bottom, volcanic mud. Dredged.

Remarks.—Carter has described some isolated spicules, found in a sandy deposit near Colon, Panama, that in form and ornamentation are almost precisely similar to the plagiotriæne (No. 1) of this sponge. They differ, however, in dimensions. In Carter's spicules the rhabdome measures 0·152 by 0·028 mm., thus being half as long again as the longest spicule in *Thrombus challengeri*, and more than twice as thick. As the spicules Carter described were not found in connection with the living sponge, we do not know what other forms might have been associated with them, and the only positive information we have as to existing differences is as regards the relative dimensions; but this appears to me sufficient to justify our assigning to *Thrombus challengeri* a separate specific name. The occurrence of such evidently closely allied species at such distant localities as Api and Panama is, however, a point of some interest.

Pores and Oscules.—Although I have sliced off the superficial layer of the sponge in several places, and made numerous transverse sections, I have not been able to discover any trace of either pores or oscules. The excurrent and incurrent canals, and their connection with the flagellated chambers, have however been clearly observed (Pl. VIII. figs. 36, 39). The middle layer of the sponge chiefly consists of a peculiar form of collenchyma, embedding granular cells (Pl. VIII. figs. 35–38). The granular cells are round or oval in outline, about 0·016 to 0·02 mm. in diameter, sharply defined, but without a differentiated cell-wall, finely and evenly granular throughout, and staining, but not very deeply, with hæmatoxylin. The nucleus and nucleolus are not easily found, but may occasionally be seen, the former as a spherical vesicle about 0·005 mm. in diameter, and the latter as a small deeply stained spherule within it. These cells lie in cavities of the collenchymatous matrix, which they completely fill, the line of demarcation between the cell and the matrix being a sharply defined one. The matrix of the collenchyma presents itself as a homogeneous transparent substance, which stains with hæmatoxylin; scattered through it are deeply stained round or oval bodies, about 0·003 mm. in diameter, which are the nuclei of the collencytes; associated with them is a small quantity of protoplasm, which is produced into the usual branching processes, or extended only in two directions, rendering the collencyte fusiform. The dark nuclei, like little black commas, and the round, more lightly stained, granular cells, immersed in the structureless collenchymatous matrix, contribute to produce a very striking and characteristic appearance.

The relative abundance of granular cells and collenchyma varies greatly; in some parts the cells are closely collected together, the collenchyma being reduced to the thinnest partitions between them; in others the granular cells are fewer, and are separated by intervening collenchyma more than their own diameter in width. The granular cells

appear to undergo but little change, while the collenchyma is subject to considerable modification; in some places, sometimes near the exterior surface, sometimes in the neighbourhood of the water-canals, the vesicles which contain the granular cells become enlarged at the expense of the intervening collenchyma, which is reduced to forming the thin film-like walls of irregular cavernous spaces; the matrix then ceases to stain with hæmatoxylin, and the collencytes, which do not lose this property, become all the more visible. The granule cells remain within the enlarged vesicles unchanged, appearing now dark on the light ground of the field of the microscope, but little interfered with by the remaining collenchyma; while in the case first described they appeared as lighter bodies on the darker ground of collenchyma. Next to the epithelium of the water-canals the granular cells are frequently arranged in a single close layer forming an investing wall (Pl. VIII. fig. 36).

This peculiar form of collenchyma is similar to that met with in *Pachastrella abyssi* and in so many species of Lithistids.

The ectosome, 0·4 mm. in thickness, differs from the choanosome chiefly in the absence of flagellated chambers, partly in minor details (Pl. VIII. fig. 35). The collencytes are frequently modified into elongated fusiform cells not more than 0·02 to 0·04 mm. long; running parallel to the surface, sometimes in great numbers, they give to the ectosome a fibrous appearance. A few of such fusiform cells may be directed at right angles to the surface, their distal ends terminating against the outer epithelium. The finely granular cells are as a rule rarer in the ectosome than elsewhere.

The epithelium of the water-canals is rendered very evident by the deep stain taken by the nuclei of its component cells (Pl. VIII. fig. 36); by the presence of these little almost black dots the epithelium can be traced throughout the canals right up to the flagellated chambers, where it becomes replaced by the usual choanocytes. The flagellated chambers vary from about 0·02 mm. in diameter to 0·02 by 0·0275 mm.; the incurrent canal passes into them by a prosodus, and they communicate with the excurrent canal by a long aphodus; both prosodus and aphodus are frequently obliterated so far as their cavity is concerned, but they can still be easily traced by the line of apposed epithelial nuclei where their walls are in contact.

In the young state the spicules are smooth (Pl. VIII. figs. 32–34) and not spined, with very slender cladi and rhabdome, the former curved usually more or less sigmately; the deuterocladi of the dicho- and tricho-cladose forms are relatively much shorter in the young state than subsequently (Pl. VIII. figs. 33, 34). They are then suggestively similar to the trilophose candelabra of *Placina trilopha*, F. E. Schulze (p. 279). In one or two instances a young spicule was observed within a scleroblast (Pl. VIII. fig. 38); the adult spicule has not been observed in connection with a scleroblast, but nuclei similar to those of the collencytes are sometimes to be met with, forming a series down its sides (Pl. VIII. fig. 37).

Supplementary Account of Species of Microsclerophora not in the Challenger Collection.

Family I. Placinidæ, F. E. Schulze.

Microsclerophora with tetractinose, triactinose, and diactinose asters, and sometimes mono-, di-, or tri-lophose candelabra. The canal-system is either eurypylous or aphodal; the mesoderm chiefly collenchymatous. The sponge is divided into a hypomere and spongomere.

Genus 1. *Placina*, F. E. Schulze.

Sponge.—Thin, flat, incrusting the under sides of stones or other foreign bodies. From the free surface one or more oscular tubes project. Canal-system eurypylous, mesoderm scanty, entirely collenchymatous. The spicules are tetractinose, triactinose, and diactinose asters and candelabra.

Placina monolopha, F. E. Schulze.

Plakina monolopha, F. E. Schulze, Zeitschr. f. wiss. Zool., Bd. xxxiv. pp. 407, 448, pl. xx. figs. 1–7; pl. xxii. figs. 22–29, 1880.

Sponge.—Thin, flat, incrusting, margin irregularly rounded, or lobate, lobes sometimes anastomosing; raised into a smooth wall by a continuation upwards of the hypomere, one or more oscular tubes proceed from the margin. Surface minutely mammillated. Pores split-like openings in the intervals between the mammillæ. Hypomere simple. All the pinnacocytes bear flagella. Hermaphrodite.

Spicules.—1. *Asters*, tetractinose (*microcalthrops*), triactinose (*microtriods*), and diactinose (*microxea*); actines straight or curved, of the asters 0·025 to 0·03 mm. long, of the microxeas, from 0·035 to 0·045 mm. in total length. 2. *Candelabra*, monolophose, the three simple actines usually curved, simply or sigmately.

Colour.—Pure white, or faint rose colour; size, small, 1 to 3 mm. in thickness.

Habitat.—Trieste, Lesina and Naples; from 1 to 2 fathoms.

Placina dilopha, F. E. Schulze.

Plakina dilopha, F. E. Schulze, Zeitschr. f. wiss. Zool., Bd. xxxiv. pp. 422, 448, pl. xx. figs. 8–11, 18; pl. xxii. fig. 30, 1880.

Sponge.—Irregular, round, incrusting plates, without a marginal wall. Oscular tube not marginal. Pores simple round openings of different sizes. Hypomere simple; ectosome thin.

Spicules.—1. *Asters*, similar to those of *Placina monolopha*. 2. *Candelabra*, dilophose, the lophose actines directed obliquely towards the outer surface.

Colour.—White, glistening.

Habitat.—Trieste.

Placina trilopha, F. E. Schulze.

Plakina trilopha, F. E. Schulze, Zeitschr. f. wiss. Zool., Bd. xxxiv. pp. 427, 449, pl. xxi. figs. 12–13, 1880.

Sponge.—Irregular, plate-like, incrusting, no marginal wall. Hypomere forming a lacunar network. Ectosome traversed by a network of pore-canals. Hermaphrodite.

Spicules.—1. *Asters*, similar to those of *Placina monolopha*. 2. *Candelabra*, trilophose, or tetralophose; when trilophose the lophose actines are directed towards the external surface, the simple actine vertically inwards, *i.e.*, the spicule is orientated like a triæne.

Colour.—Yellowish-white.

Habitat.—Naples.

Genus 2. *Placortis*, F. E. Schulze.

The ectosome is traversed by a network of widely extending subdermal cavities. The canal-system is aphodal, with short, wide aphods. The choanosomal mesoderm is a granular collenchyma. The spicules are tri- and diactinose; candelabra are not present.

Placortis simplex, F. E. Schulze.

Plakortis simplex, F. E. Schulze, Zeitschr. f. wiss. Zool., Bd. xxxiv. pp. 430, 449, pl. xxi. figs. 14–16, 1880.

Sponge.—Irregular, smooth, incrusting.

Spicules.—1. *Asters*, triactinose and diactinose, the latter (microxeas) from 0·1 to 0·15 mm. in length.

Colour.—Pale yellow.

Habitat.—Naples.

Family II. Corticidæ, Vosmaer.

Microsclerophora with tetractinose asters and candelabra. The canal-system is aphodal or diplodal. The mesoderm is in part sarcenchymatous, in part chondrenchymatous.

Genus 1. *Corticium*, O. Schmidt.

The mesoderm of the ectosome and hypomere consists of chondrenchyma, which also forms the walls of the larger water-canals. The spicules are tetractinose asters and heterolophose candelabra.

Corticium candelabrum, O. Schmidt.

Corticium candelabrum, O. Schmidt, Spong. Adriat. Meeres, p. 42, pl. iii. fig. 25, 1862.
" " Kölliker, Icones Histiologicæ, p. 67, 1864.
" " O. Schmidt, Spong. Adriat. Meeres, Suppl., ii. p. 2, pl. i. fig. 2, 1866.
" " F. E. Schulze, Zeitschr. f. wiss. Zool., Bd. xxxv. p. 410, pl. xxii., 1881.

Sponge.—Massive, irregularly rounded or nodular, with a smooth surface; or plate-like, flat, thin, incrusting, irregularly lobate, with a more or less smooth or tubercular surface; when very young, up to 1 mm. in diameter, rounded knob-like, attached by the flat lower surface of the hypomere. Pores, the simple circular openings of the incurrent canals, of various size, up to 0·3 mm. in diameter. Oscule, a slit-like opening in the hypomere. Canal-system diplodal, flagellated chambers pear-shaped, 0·045 mm. in diameter. The pinnacocytes of the outer surface and the adjacent chondrocytes contain pigment granules.

Spicules.—1. *Microcalthrops*, uniformly strewn through the mesoderm; actines usually curved sigmately, 0·036 to 0·04 mm. in length. 2. *Candelabra*, the cladi of the ecactine spined on the outer convex side, those of the esactines fewer in number and smooth, not spined. The candelabra form a single layer beneath the epithelium of the exterior and of the larger water-canals.

Colour.—Light yellow, brown, black, probably dependent on locality. Size, up to 60 mm. in diameter.

Habitat.—The Adriatic (O. Schmidt) and Zebu (F. E. Schulze).

Corticium versatile, O. Schmidt.

Corticium versatile, O. Schmidt, Spong. Meerb. Mexico, p. 69, pl. ix. fig. 5, 1880.

Sponge.—Forming crusts.

Spicules.—*Candelabra*, actines variously cladose, one frequently acladose. The number of cladi borne by each actine varies from two to five.

Habitat.—St. Vincent; depth, 95 fathoms.

Genus 2. *Calcabrina*,[1] n. gen.

Corticidæ containing spinose microrabds, in addition to tetractinose asters or candelabra.

[1] A proper name, *vide* Dante, Inferno, canto xxi. line 118.

Calcabrina plicata (O. Schmidt).

Corticium plicatum, O. Schmidt, Spong. Algiers, p. 2, pl. iii. fig. 11, 1868.

Sponge.—Incrusting, intergrown with a calcareous Alga. Surface very irregular, with depressed conical elevations and papillæ.

Spicules.—1. *Tetractinose asters*, the actines usually conical, oxeate, simple, seldom dichocladose; length of an esactine 0·06 mm. 2. *Microrabds*, irregularly spined, 0·0083 mm. in length.

The microrabds are accumulated in a dense layer beneath the outer epithelium. So numerous are they as to render the papillæ of the surface greyish-white, while the sponge as a whole is of a pale yellow colour.

Habitat.—Algiers.

Genus 3. *Corticella*, n. gen.

Corticidæ containing polyactinose as well as tetractinose asters.

Corticella stelligera (O. Schmidt).

Corticium stelligerum, O. Schmidt, Spong. Algiers, p. 25, pl. iii. fig. 6, 1868.

Sponge.—An irregular crust, growing on *Caryophylla cæspitosa*. Pores scattered.

Spicules.—1. *Tetractinose aster*, the three esactines are each about 0·33 mm. in length, the ecactine not quite 0·1 mm. 2. *Strongylaster*, actines slender, long, four to six in number, and one or two shorter, reduced to tubercles; diameter, 0·05 mm. 3. *Aster*, with six to twelve short actines with wavy outline, 0·02 mm. in diameter. This spicule occurs in great numbers, along with the tetractinose aster (No. 1), in the outer skin of the sponge.

Colour.—White. Size, about 5 mm. in thickness.

Habitat.—Sebenico and Algiers.

Genus 4. *Rhachella*,[1] n. gen.

Corticidæ (?) characterised by polycladose calthrops.

Rhachella complicata (Carter).

Samus complicatus, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 61, pl. v. fig. 27, 1880.

Sponge.—Excavating.

Spicule.—Microscleres. 1. *Cladocalthrops*, with actines repeatedly dichotomising actinome 0·084 mm. in length, protocladus 0·051 mm., deuterocladus very short, trito-

[1] ῥάχος, a thorn-bush.

cladus 0·045 mm., tetracladus 0·02 mm.; maximum diameter of the calthrops, measured from the extremities of the most remote rays, 0·324 mm.

Habitat.—Seychelle Islands, in deep water.

Remarks.—The description of the calthrops is taken from a slide kindly presented me by Mr. Carter, who found it associated with débris at the root of a specimen of *Euplectella cucumer* from the Seychelles. The spicule is unique in form, and brings to mind the tetracladine desmas of the Lithistida. The resemblance extends into details, the actinomes being thickened ridge-like on their confluent sides, so as to produce a triangular depression at each point of union of the actinomes taken in threes. A precisely similar character will be found described in *Theonella swinhoei*, pp. 285, 290.

The chief distinction between this spicule and a Lithistid desma is to be found in the axial fibre, which in the spicule extends throughout the cladi up to the extremity of the tetracladus, while in the Lithistid desma it never extends past the protocladus; another probably equally important difference is presented by the cladi, which are more or less cylindrical or conical according to their position, but never expanded into laminæ, and rigidly straight, never crooked. The difference in size is also worthy of remark.

[*Corticium parasiticum*, Carter.

Corticium parasiticum, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 229, pl. xvi. fig. 52, 1876.

This species evidently belongs to the Monaxonida.

Family III. Thrombidæ.

Thrombus abyssi (Carter.)

Corticium abyssi, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. pp. 18–22, pl. i. figs. 1–9, 15, 1873.

Sponge.—Reptant, amorphous; surface smooth, slippery; oscules numerous, small, of different sizes, congregated now and then irregularly; pores simple, not in sieves, uniformly scattered; mesoderm similar to that of *Thrombus challengeri*.

Spicules.—1. *Trichotriæne*, rhabdome straight, ornamented with conical erect spines, except between the actinal and cladal centres; esactine conical, oxeate; ecactine cylindrical, strongylate; cladome arising from the middle of the ecactine, cladi trichotomate, protocladi smooth, deuterocladi spined like the rhabdome. Rhabdome 0·0583 mm. long, chord of the cladome 0·0542 mm.

2. *Amphiaster*, axis straight, slender, bearing four recurved spines at each end; 0·005 mm. long.

Colour.—Light yellowish-grey.

Habitat.—Western entrance of English Channel; about lat. 48° 31′ N., long. 10° 3′ W.; depth, 500 fathoms.

Remarks.—From Carter's description it is evident that this sponge is remarkably similar in the character of its tissues to *Thrombus challengeri;* the chief difference between the two species lies in the absence of amphiasters in the latter.

Thrombus ornatus, n. sp.

Sponge.—(?).

Spicule.—1. *Trichotriæne*, rhabdome cylindroconic, 0·065 mm. in length; cladome terminal, cladi curving gently forwards, outwards and backwards, protocladi 0·008 mm., deuterocladi 0·198 mm. in length, chord 0·055 mm., the esactinal rhabdome and the deuterocladi minutely, entirely, and erectly spined, the protocladi and ecactine smooth.

Habitat.—Seychelle Islands.

Remarks.—The spicule on which this species is founded occurs not uncommonly among the débris which Mr. Carter obtained from about the rooting spicules of *Euplectella cucumer*, and of which he was good enough to present me with a mounted slide. The difference between this trichotriæne and that of *Thrombus abyssi* is to be found in the position of the cladome, which is not terminal in the latter species.

Thrombus kittoni (Carter).

Corticium kittoni, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xiv. p. 24, pl. xv. fig. 48.

Sponge.—Unknown.

Spicule.—1. *Sigmatriæne*, rhabdome short and stout; cladi varying from two to four in number, spreading upwards and outwards *en fleur-de-lis;* both rhabdome and cladi thickly covered by stout, vertical, short spines, except near the cladal origin. Rhabdome 0·154 by 0·028 mm.; total length of spicule 0·268 mm.

Habitat.—Colon, Panama.

This species is founded on deciduous spicules from an "arenaceous deposit," so that it is presumably fossil. The description is taken from Carter's account, but there seems to be some discrepancy between the text and the illustrations; in the text the cladi are said to be twice the length of the rhabdome, while in the figure the reverse is represented.

Order II. LITHISTIDA, O. Schmidt.

Tetractinellida provided with a consistent skeleton by the zygosis of modified spicules or desmas.

Suborder I. HOPLOPHORA.

Lithistida provided with special ectosomal spicules, and usually with some form of microsclere.

Demus I. Triænosa.

Hoplophora in which the ectosomal spicules are some form of triæne, and in which microscleres (spirasters, amphiasters, or microrabds) are invariably present.

Family I. Tetracladidæ (Zittel).

Triænosa in which the desma is tetracrepid.

Genus 1. *Theonella*, Gray.

Tetracladidæ with a large single oscule, the external opening of an axial cloaca, or with numerous oscules dispersed on the interior surface of a cup-shaped sponge; pores in sieves, generally distributed over the exterior. The ectosomal megasclere is a phyllotriæne; discotriænes are absent. The microsclere is a microstrongyle.

Theonella swinhoei, Gray (Pls. XXIX., XXX.).

Theonella swinhoei, Gray, Proc. Zool. Soc. Lond., pp. 565, 566, woodcut, 1868.
" " Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 437, 1873.
" " Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 103, 151, pl. i. fig. 9, 1878.
" " Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 147, 1884.

Sponge (Pl. XXIX. figs. 1–3).—Simple, erect, attached, more or less cylindrical, with a smooth surface, raised into unequal irregular bosses and high, sinuous, longitudinal and transverse, anastomosing ridges. The single circular oscule is situated in the centre of the rounded summit, surrounded by a smooth wrinkled membrane. It leads into a cylindrical cloaca, which extends axially through nearly the whole length of the sponge, and is lined by a network of collenchyma, limited by a smooth shining concentrically ridged or plicated membrane, fenestrated by a multitude of small oval apertures, and perforated by larger openings, which lead into the main branches of the cloaca.

These branches—the main excurrent canals—traverse the wall of the sponge, chiefly obliquely outwards and downwards, sometimes extending as far as the ectosome. They are lined by an extension of the collenchymatous layer of the chief excurrent tube. Pores (Pl. XXX. figs. 3, 4) generally distributed, except on the summits of the ridges, where they are rare or absent; leading into subdermal cavities (Pl. XXX. figs. 1, 2, 5), which join together to form irregular sinuous canals, having a somewhat stellate arrangement, seen as dark spaces through the skin. The centre of each stellate system is situated within one of the depressions left between the ridges of the surface; usually several such centres lie within a single depression. Each centre marks the outer end of an incurrent canal, which descends, with a usually downward and inward direction, into the choanosome; it is lined by a collenchymatous layer, similar to that which forms the walls of the larger excurrent canals.

Spicules.—I. Megascleres. 1. *Desma* (Pl. XXIX. figs. 7, 7*a*), characterised by four triangular depressions, symmetrically disposed around the centre, one in each of the angles formed by the four diverging epactines. Each epactine is triradiate in transverse section near its origin, being raised into three strong longitudinal ridges; and it is by the confluence of these ridges about the centre that the triangular depressions which they bound are produced. At some distance from the origin the epactines become more or less cylindrical in section, and still more distally flatten out, so as to acquire a much depressed elliptical section. They may or may not bifurcate before growing out into a number of little elongated tubercles, which are often bifid; if they bifurcate, the tubercles are produced from any or all parts of the protocladi, if they remain simple, from the ends of the epactines. Zygosis is terminal, and is produced by the intergrowth of the syzygial tubercles, which seldom form laminar processes. Sometimes the angle between the two protocladi of an epactine is webbed across by an extension of their adjacent inner margins; in this way the epactine sometimes comes to end in a flat triangular plate, the distal base of which grows out into syzygial tubercles.

The epactines and cladi of the desmas are very variable in their dimensions; most commonly the epactines measure, when simple, about 0·16 to 0·24 by 0·04 mm.; when bifurcate, the epactine exclusive of the cladi is from about 0·05 to 0·125 mm. long.

The axial fibre of the crepis extends from its origin into the epactine, as a rigidly straight rod, for a distance of 0·04 to 0·06 mm.; it then abruptly terminates, and its direction is continued by a series of granules, which branch out into two series at the points of bifurcation.

2. *Phyllotriæne* (Pl. XXIX. figs. 4, 4*a*-*e*), a short, conical rhabdome, about 0·13 to 0·16 by 0·019 mm., rounded off at the end; cladi of very various lengths, usually about 0·26 to 0·32 mm. long, diverging at various angles with each other, but perpendicularly to the rhabdome; more or less flattened in a horizontal plane; straight, or more usually irregularly curved; margin undulating; simple or bifurcate, or with accessory

branches; angles between the protocladi, or between the deuterocladi, sometimes filled up by a marginal growth to form a plate. A strong ridge runs from the lower surface of each cladus down the sides of the rhabdome. The axial fibre in the rhabdome extends from the origin to the end, but in the cladi it usually ceases at a distance of about 0·13 to 0·026 mm. from the origin, beyond this it is represented by a series of granules scattered about the axial region.

3. *Strongyle* (Pl. XXIX. figs. 6–6*d*), cylindrical, slightly curved, with rounded ends one or both sometimes becoming tylote. The axial fibre is invariably enlarged at each end, usually into a somewhat tassel-shaped form, *i.e.*, first into a smaller rounded expansion, and then into a larger somewhat cylindrical rod. It is remarkable that in most cases this expansion of the axial fibre has no effect on the outward form of the spicule, the cylindrical rhabdome continuing unchanged in diameter up to its termination. Size, 0·59 by 0·011 mm. These spicules are collected together in fibres, which are chiefly distributed about the water canals, to the course of which they run parallel.

II. Microsclere. 4. *Microstrongyle* (Pl. XXIX. figs. 5–5*c*), cylindrical, with roughened surface and rounded ends, usually bent in the middle, sometimes straight, sometimes almost tricurvate, 0·0237 by 0·0039 mm. In its earliest observed stage it presents itself as a straight, curved, or tricurvate rod, smooth, and of hair-like fineness. These spicules are scattered through the collenchyma immediately beneath the epithelium, which invests the exterior, and lines the canals. About the pores they lie with their concavity concentric with the curved outline of the poral margin, which, however, they do not reach; the thin membrane immediately surrounding the lumen of the pore is free from spicules.

Colour.—Faint greyish-white.

Habitat.—Station 208, off Manila, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; depth, 18 fathoms; bottom, blue mud. Trawled.

Formosa, Gray.

Remarks.—A single complete specimen and a few fragments of this sponge were trawled. The complete specimen measures 143 mm. in height, by 28 mm. in width where narrowest, and 48 mm. where widest. The base is broken from its attachment, a cylindrical hollow cavity, 16 mm. in diameter, rises vertically upwards within it to a distance of about 25 mm., and then ends bluntly. The oscule is about 6 mm. in diameter, the cloaca into which it leads is about 13 mm. wide near the oscule, where it is widest, its length is 107 mm.; the layer of transparent, colourless collenchyma, which forms its wall, is as much as 6 mm. thick about its lower end, but becomes much thinner towards the oscule, so that in the upper region of the tube it is not more than 1·2 mm. thick.

Ectodermal and Endodermal Epithelium.—The presence of an epithelium which invests the exterior of the sponge and the free surface of all the canals can be readily

made out, usually as a thin membrane dotted with nuclei; but sometimes, though very exceptionally, and then only on the surface of the water canals, it is possible to make out the outlines of its constituent polygonal cells (Pl. XXX. figs. 15, 16).

Ectosome.—The ectosome, about 0·725 mm. in thickness, consists of a collenchyma, the matrix of which takes a well-marked stain with hæmatoxylin, it contains numerous fusiform cells which, near the outer epithelium, are arranged tangentially, forming a thin layer two to four cells deep. In Pl. XXX. fig. 6, these cells are represented in the neighbourhood of a pore. The pores, from 0·011 to 0·032 mm. in diameter, lie in pore-sieves and open each into a small dome-like cavity, and these again into a larger dome, which forms the outer end of a cylindrical canal, freely open below into the subdermal cavity (Pl. XXX. fig. 5). This arrangement recalls that described in the Stellettid genus *Myriastra* (p. 114), and in *Anthastra, e.g., Anthastra communis* (Pl. XII. fig. 24).

Choanosome.—The mesoderm is mainly a sarcenchyma, but it includes other forms of tissue; thus the lining of the chief canals and their main branches consists of a thick layer of cavernous collenchyma (Pl. XXX. figs. 9–11). The desmas of the sponge, with their associated sarcenchyma, cease at a fairly uniform distance around the canal, thus bounding a tubular space devoid of megascleres; the cavity of the canal occupies the central one-third or one-half of this tube, and is limited by an epithelial layer. Between the epithelium and the skeleton there is thus an annular space, and this is occupied by the collenchyma, the cavities of which are elongated radially to the axis of the canal (Pl. XXX. fig. 10). The partitions between the cavities are mere films of collenchyma traversed by a network of collencytes, most of which are elongated radially; fusiform cells directed radially are also present. The presence of some such tissue I had assumed to exist before I had seen a specimen of a Lithistid with the flesh on, in explanation of certain peculiarities observed in fossil Lithistids. Although not of anatomical significance, these peculiarities, from their problematical character, had excited some interest, and I venture, therefore, to quote here my previously given account of them.[1]

"The smaller canals of the sponge [*Emploca ovata*, Soll.], both incurrent and excurrent, are generally traversed axially by a thin thread of calcite, the rest of the canal being filled up with consolidated calcareous mud. [Quenstedt describes similar threads in the superficial canals, now exposed as shallow grooves in *Siphonia radiata*, *vide* Petrefact. Deutschlands, part i. Bd. v. p. 251, pl. cxxvi. figs. 60*z*.] In describing the *Siphoniæ* of the Blackdown greensand, I mentioned a similar thread (Quart. Journ. Geol. Soc., vol. xxxiii. p. 814), but in that case consisting of silica, and separated by an empty space from the adjoining skeleton. It was conjectured that this thread had been produced from colloidal silica, which originally filled the whole of the canal from side to side, but subsequently on undergoing silicification shrank to its present dimensions. Since, however, in other sponges we now find precisely similar threads, but consisting of

[1] *Quart. Journ. Geol. Soc.*, vol. xxxix. p. 543, 1883.

calcite, which, unlike silica, is not known to originate from a colloidal state, recourse must be had to a different mode of explanation, and the following may be suggested.

"In some sponges—*e.g.*, *Thenea wallichii*—the walls of the canals in the living state are formed by a considerable thickness of gelatinous connective tissue, from which the body spicules are absent, these occurring immediately about the exterior of the gelatinous tissue. If such a sponge should soon after death become covered up by fine calcareous mud, it is quite conceivable that the entrance of solid particles of foreign material might be prevented for a time by the presence of an investing skin and other soft tissues; on the other hand, this would not prevent the entrance of mineral solutions, which, penetrating the interior, might deposit in the vacant canals calcite or silica, as the case might be. Subsequently the organic matter would be dissipated by decomposition, and the fine calcareous mud, no longer excluded, would be able to insinuate itself into every space thus left vacant, and so fill up the cavity which would intervene between the thread of calcite or other mineral which had already been deposited, and the walls of the surrounding skeleton. Thus the problematical threads of our fossil sponge may be regarded as representing the original cavities of the canals; while the consolidated mud, or empty space, as the case may be, *has taken the place of once-existing gelatinous connective tissue*. How far this, which is the only explanation I can suggest, is the true one, it is hard to say. One difficulty on the face of it is the rapidity which it seems to require in the rate of deposition of the minerals now forming the axial threads; but till we know more about the durability of certain organic tissues, and the rapidity with which mineral deposition takes place in shallow warm seas, this objection cannot be regarded as a fatal one."

As the structure assumed in the foregoing explanation has now been observed to exist, the explanation itself becomes much strengthened, and that mineral deposition proceeds under certain circumstances with a greater celerity than has hitherto been suspected appears probable. The parallelism between the structure of the canal-wall in this species of *Theonella* and in some species of *Thenea*, *e.g.*, *Thenea muricata*, and more particularly in the position of the spicules or desmas of the general skeleton, is suggestive enough to merit notice.

The mesoderm also contains numerous fibrous strands, consisting of fusiform cells arranged longitudinally side by side with overlapping ends (Pl. XXX. figs. 13, 17). Occasionally one of these cells is met with prolonged into two processes at one end, and at intervals cells of quite a different character occur; these are larger, oval, and densely granular (two instances not very well represented are shown in fig. 13). They are prolonged at one or both ends into a slender thread-like process, and take a comparatively deep stain with reagents. The fibrous strands sometimes run more or less parallel to the wall of one of the water-canals, but this is not always the case, and frequently it is quite impossible to correlate their direction with that of any other structure in the sponge. In

the collenchymatous lining of the cloaca similar fibrous strands are longitudinally and concentrically arranged; fusiform cells also concentrically surround the fenestræ by which the excurrent canals open into the cloaca. Isolated fusiform cells are always present near the margins of the fenestræ, arranged radiately, and with one end in connection with the outer epithelium.

Flagellated Chambers (Pl. XXX. figs. 7, 8).—These are almost spherical, measuring 0·024 by 0·026 mm. They are aphodal, the apopyle frequently measuring 0·012 mm. in diameter. The choanocytes, which are about 0·008 mm. in length, are of the usual nature, a deeply stained basal part containing the nucleus contrasts with a transparent collum which does not stain, and is indicated by two sharply marked marginal lines. So clearly marked are these lines as to suggest sometimes the appearance of a conical tube rather than a collum; they terminate in the usual fenestrated membrane (Pl. XXX. fig. 8).

Symbiosis or Parasitism.—The sponge is infested throughout with a form of Cyanophyceous protophyte, which is so abundant as to constitute a really important part of the tissues. It usually presents itself as narrow jointed threads, 0·004 mm. in diameter, and of considerable length; the joints of the threads are sometimes square in lateral optical section, like those of an *Oscillaria*, sometimes round, like those of a *Nostoc*; they measure about 0·004 mm. in length. Besides the threads isolated spherical protophytes are very abundant in places, particularly in the ectosome; they measure about 0·007 mm. in diameter, and present a thick double-contoured wall and finely granular contents. These are represented in Pl. XXX. figs. 12, 14, the thread-like forms are shown in the neighbourhood of the flagellated chambers in fig. 7, and amidst the fusiform cells of a fibrous thread in fig. 14. In the latter it will be noticed that they run parallel with the fusiform cells, and this they do invariably.

Spicules.—The strongyles, which are usually collected into spicular fibres, are best studied where they traverse the collenchyma of the cloaca, since the matrix of this tissue in this place is perfectly colourless and transparent, and not affected by staining reagents. Many of them are here met with, surrounded by a deeply-stained, faintly granular spicular sheath, in which in a few instances I thought I detected an oval nucleus with its nucleolus; if so, this sheath may be regarded as the scleroblast; most of the strongyles are without the sheath, and this would suggest that when the spicule is fully formed the scleroblast disappears; in other words, the scleroblast remains active for only a limited period, during which the spicule increases in size; when its secretive power is exhausted, the spicule has attained its limit of growth, and the scleroblast is absorbed.

Spongin.—In numerous instances a homogeneous non-granular substance, taking a deep stain with hæmatoxylin, was noticed in association with the strongyles; it is most obvious at the points where two strongyles cross each other, frequently forming at the junction a comparatively large mass; it has all the appearance of spongin.

The illustration (Pl. XXX. fig. 17) represents the spongin uniting two crossed spicules as granular—it is not really so; and the margins of a spongin mass are usually more sharply marked than in the illustration.

Development of the Desma.—The desmas commence within a large mother-cell as minute calthrops with cylindrical actines (Pl. XXX. figs. 20, 21), the surface of the spicule presents the eroded appearance characteristic of most very young forms of spicules; its actines measure about 0·016 mm. in length, and an axial fibre extends from their origin to their termination, so that the whole spicule is moulded on a tetrad axis. In this stage it resembles the young calthrops of *Dercitus* and its allies. The mother-cell, about 0·028 mm. in diameter, consists of granular protoplasm, which stains deeply with reagents, and presents an oval nucleus, about 0·008 mm. in diameter, with a small, spherical nucleolus. It now occupies (after treatment) a cavity in the granular collenchyma. In the next stage, when the actines are about 0·06 mm. long, the characteristic form of the central part of the adult spicule has already originated. The young actines have now the form of triangular daggers with hollow faces (Pl. XXIX. figs. 8, 8*a*-*b*), and may be readily represented by folding a triangle of paper into a three-sided pyramid, and pinching in the sides; if four such pyramids be joined together at their bases, so that their edges are confluent, a model of the young spicule will be produced. The model will be exact except in one particular, it will not represent the webbing of the angles of the young spicule produced by an extension outwards of the confluent ridges. This feature may readily be added to the model by gumming triangles of paper with a concave base across the angles, so that the concave curve continues the direction of the ridges. The young spicule still presents a deeply eroded surface, the pits frequently perforating it, so that it looks almost like a network of silica rather than a solid structure. With further growth the erosion disappears, the surface becomes smooth and even, the sharp edges of the actines thicken into rounded ridges, the triradiate depressions about the centre become circumscribed, and finally, towards the distal extremities, the actines or epactines, as we may now call them, assume a cylindrical form, and, sometimes bifurcating, sometimes not, break out into the tubercles characteristic of the adult. The tubercles are at first slender, somewhat twig-like processes, and their intergrowth takes place in the following manner:—The contiguous epactines or their cladi are covered with tubercles on their apposed faces, and owing to their numbers, proximity, and direction of growth, they cannot enlarge unhindered—they are constantly encountering one another. A very general case is where one tubercle in its forward growth is hindered by another growing at right angles to it, so that the side of the latter is opposed to the growing end of the former; this in consequence subdivides, or becomes bifid, and continuing its onward direction it encloses its opponent on each side. The increase in thickness of both the enclosing tubercle and its opponent, which it has taken prisoner, leads to a mutual adaptation of the closest kind, though, however close it may become, a thin film of tissue

always intervenes, and the outlines of the corresponding tubercles are consequently always separately distinguishable. It frequently happens that one process of a bifid tubercle not only clasps its prisoner, but is itself attacked and partly surrounded by a third; in this and other ways the complication of the interlocking is increased almost beyond the powers of analysis. The mother-cell, increased in size, persists in the adult spicule, occupying one of the triangular depressions about the centre, from which, as a thin film of granular protoplasm, it extends over the surface. The diameter of the scleroblast of the adult desma is about 0·03 mm., of the nucleus 0·012 mm., and of the nucleolus, which is spherical, 0·004 mm. In several instances similar scleroblasts were observed in each of the other depressions about the centre of the desma, and occasionally nuclei of the same dimensions as those of the evident scleroblast were observed on the epactine at some distance from the centre; a not very good example of this is shown in Pl. XXX. fig. 19. Sometimes also a nucleus could be recognised in the material filling up the space between the syzygial tubercles of apposed cladi (Pl. XXX. fig. 18); unless these appearances are deceptive, they certainly show that more than one scleroblast may take part in the formation of the desma, and I am the less disposed to mistrust them from the fact that the nuclei associated with the desma are frequently altogether disconnected from the surrounding mesoderm, which, owing to treatment with reagents, has shrunk away from the desma, leaving the nuclei observed adherent to its surface.

The Form of the Phyllotriænes.—The irregularities in the form of these spicules, which appear at first altogether capricious, are determined entirely by two factors; the position of the cladus, in the first place relative to the adjacent canals, in the next to contiguous spicules. The spicules are arranged in the ectosome in five or six successive layers parallel to the surface, the rhabdomes descending inwards through the walls which bound the subdermal cavities, the cladi extending horizontally parallel to the surface within the walls which separate the poral domes from each other. The direction of the cladi is chiefly determined by the direction, in a horizontal plane, of the wall into which they extend, and the form of their marginal outline is to some extent, more particularly in the case of the more superficial spicules, determined by the outline of the poral domes. Thus, should the origin of the cladome of a spicule lie midway between three approximately equidistant domes, the cladi will radiate through the three walls which separate the domes from each other; should one or other of the cladi encounter another dome midway in its course it will bifurcate, and the resulting deuterocladi will pass one on each side of this dome, whose position thus determines the position of the point of bifurcation of the protocladus (if not actually inducing it), and the subsequent direction of the deuterocladi. The marginal outline of a cladus traversing the middle of a somewhat thick partition between two domes is not much, if at all, influenced by the free surface of the domes; but when a cladus approaches the free surface of a partition, or when the partition is so narrow that the sides of the cladus are not far from the free

surface of the domes on either side, then a lateral horizontal growth takes place, till the cladal margin is exactly adapted to the curved sides of the adjacent dome. So, too, should a cladus bifurcate at a little distance from an opposing dome lying directly in its course, the angle of bifurcation becomes filled up by a horizontal growth till the margin of the dome is reached. And again, should three domes, occupying the angles between the protocladi of a spicule, lie near enough to the centre of the cladome, then these angles also become filled up, and the cladome assumes a plate-like form, with curvilinear notches, corresponding to the curved sides of the domes. Thus, with regard to the poral domes, the tendency of the cladi is to grow out into flat plates extending up to them. This tendency is disturbed by the interference of the spicules one with another. If a growing cladus encounters the rhabdome of a spicule belonging to the series next above it, it bifurcates, the deuterocladi passing on each side of the rhabdome, or it curves round it without bifurcating. If a cladus, after bifurcating to adapt its outer margin to the outlines of two domes which lie behind and on each side of the point of bifurcation, encounter the cladus of another spicule at right angles, the angle of bifurcation becomes filled up by lateral growth, and a triangular plate results, the distal base of which is accurately adapted to the side of the opposing cladus.

This freedom and adaptability on the part of the cladome is in striking contrast to the rigidity of the rhabdome of these spicules, to the rigidity of the cladi of the homologous ectosomal spicules of some other Lithistids, and of all Choristids, and, in a word, to the rigidity of all spicules, traversed throughout by a continuous axial rod. The submissiveness of the cladi of the spicule to the influence of the environment is therefore in all probability correlated with the suppression of the clad-axial fibres, which, as we have already seen, extend but an insignificant distance from their origin, while the axial fibre of the rhabdome extends from origin to end.

Genus 2. *Discodermia*, Bocage.

Tetracladidæ in which some of the ectosomal megascleres are discotriænes, and the microscleres are microxeas and microstrongyles; with differentiated oscular and poral surfaces; the pores are simple, singly distributed, the oscules are numerous and simple.

Discodermia discifurca, n. sp. (Pl. XXXII. figs. 1–11).

Sponge (Pl. XXXII. fig. 1).—Irregularly cup-shaped; two or more cups borne on a stout pedicel, which ends below in a flat, somewhat expanded, attached base. Walls of the cup thick, cavity shallow, margins rounded. Large oval openings on the exterior lead into winding tubular involutions of the external surface. Oscules confined to the inner surface of the cup; pores single, irregularly dispersed over the external surface.

Spicules.—I. Megascleres. 1. *Desma* (Pl. XXXII. figs. 4, 5), in the young adult state quadriradiate, with smooth cylindrical epactines, simple or branched, with triangular depressions about the centre occupying each angle when three arms meet; in the older adult state they are sparingly tubercled, either by simple, rounded, conical tubercles, or low, transverse, crescentic ridges. The zygoses are formed by the meeting of several cladi, the tubercles intertwining to form an inextricably tangled knot. So thorough is the union that no distinction can be drawn between adapted tubercles and those to which they are adapted, every tubercle is both one and the other. At the base of the sponge the tubercles run out into elongated twig-like processes of most varied form, and these adapt themselves accurately to the asperities of the surface of attachment. The simple epactines of the desma are on average 0·25 mm. long. The axial rod extends from the centre for a distance of from 0·032 to 0·064 mm. into each epactine; in a few cases the axial rod was observed to have lost its tetrad character, the number of its rays being reduced to three (Pl. XXXII. fig. 6) or two; in others it was seen to have retained it in spite of the loss of tetrad form in the desma; in one case a desma near the base of the sponge was found reduced to a single cylindrical shaft, branched at the ends, but with the tetrad axis preserved in its midst.

2. *Phyllotriæne* (Pl. XXXII. figs. 7–9); (*a*) of the oscular surface; rhabdome short, conical, rounded at the inner end, distally expanding into thin plate-like cladi flattened in a horizontal plane; the three protocladi usually bifurcate, sometimes trifurcate, giving rise to deuterocladi, which subdivide into terminal branches with rounded margins. (*b*) Of the poral surface; similar, but in addition discotriænes having cladomes with entire margins more or less circular in outline or broadly lobate. The phyllotriænes are arranged in several layers, and when discotriænes occur they overlie the space enclosed by the curved or semicircular angles formed by the cladi of the underlying phyllotriænes. The rhabdome of the discotriæne descends perpendicularly through this space.

In some of the branched phyllotriænes a ridge runs from the rhabdome to each protocladus, producing three triangular depressions similar to those which characterise the young choanosomal desma. The cladi of the deeper-lying phyllotriænes are thicker than those of the more superficial.

The rhabdome of the phyllotriæne is about 0·16 mm. long; the cladi of the branched phyllotriænes measured from origin to end are very various in length, the largest attaining a length of from 0·32 to 0·45 mm. The discotriænes measure from 0·18 to 0·2 mm. in diameter. The axial rod extends throughout the length of the rhabdome, but not more than from 0·0118 to 0·028 mm. into the cladome. The three protocladi of the discotriæne commence like the epactines of the desma in granular or reticular silica, and they retain this granular appearance for some time, up to a length of 0·08 mm.

3. *Rhabdus.*—This was not observed, but it does not follow that it is not present.

II. Microscleres. 4. *Microxea* (Pl. XXXII. fig. 10), fusiform, sharply pointed, surface minutely roughened, 0·05 by 0·004 mm.

5. *Microstrongyle* (Pl. XXXI. fig. 11), ellipsoidal or cylindrical, with rounded ends and minutely roughened surface, 0·012 to 0·016 by 0·004 mm.

Colour.—Yellowish-white.

Habitat.—Port Jackson, June 3, 1874; depth, 30 to 35 fathoms.

Remarks.—This specimen presents a broad, thick pedicel, terminating in two shallow cups; the growth has not been vertical, but oblique, so that when the sponge is placed with its flat base on a horizontal surface, the margins of the cups are nearly vertical. The total width of the sponge across the cups is 97 mm., the major and minor axes of the margin of one cup measure 56 and 41 mm., the base measures 51 by 42 mm. The sponge is completely overgrown, save for one small patch near the base, by an incrusting Desmacidine sponge, which appears to have commenced its growth at a time when the Lithistid was alive throughout, since beneath the parasite the discotriænes of the ectosome are still preserved; while had the superficial portion of the host been dead before the growth of the parasite, these would have probably dropped off. The discotriænes are also in a quite fresh state, showing no signs of solution, and this also suggests that they have not long been dead.

With the growth of the Desmacidine over the pores of the Lithistid, the latter became starved and stifled, and in consequence began slowly to die away, till at the time it was dredged all that remained alive was a small central patch, 15 by 6 mm. in area when cut open, and a small portion near the base which had escaped the general covering up. With the decease of the Lithistid the Desmacidine extended its growth inwards, coating the Lithistid skeleton with its own choanosome for a distance of about 2 mm. inwards from the surface (Pl. XXXII. fig. 2). The small portion of the Lithistid which remained alive in the centre of the sponge was examined by means of thin slices. It consists of sarcenchyma, which stains very faintly with hæmatoxylin, traversed by small excurrent and incurrent canals, which communicate with flagellated chambers in a diplodal fashion (Pl. XXXII. fig. 3). The chambers measure 0·018 mm. in breadth, and 0·015 mm. in length. That this tissue does not belong to the Desmacidine is evident from its character, since in the latter the flagellated chambers are eurypylous and the mesoderm collenchymatous; that it does belong to the *Discodermia* is conclusively proved by the occurrence of microstrongyles and microxeas within it.

The oscules are beyond the reach of observation, the Desmacidine having completely covered them over. The pores are well shown on the surface of the exposed basal patch: they are single apertures bounded by ectosomal discotriænes and phyllotriænes, and lined by epithelium and its associated microstrongles. They are oval or circular in outline, and from 0·045 to 0·065 mm. in diameter.

The resemblance of the different species of *Discodermia* to one another is in all cases very marked; the present species appears to be distinguished by its usually smooth desma, and by the characteristic forms of its phyllotriæne, as well as by the general form of the whole sponge. It is very similar to *Discodermia calyx*, Döderlein, and may very possibly be identical with it. Döderlein represents some spined styles as occurring in *Discodermia calyx*, but it seems to me more than probable that these do not properly belong to the sponge, but to some incrusting Monaxonid. From *Discodermia ornata* it is distinguished by the character of its desma, and from *Discodermia panoplia* by this character and the form of its phyllotriæne, such forms as those represented in figs. 7–9, for instance, not being present in the latter sponge.

As Döderlein has already pointed out, the claims to generic distinction of *Racodiscula*, Zittel, so far as they are founded on the form of the phyllotriænes, fail through the association of both *Racodiscula* and *Discodermia* forms in the same sponge; the same remark will probably be found to apply to Zittel's fossil genus *Rhagadinia*,[1] the discotriænes which he regards as distinctive being similar to those of *Discodermia panoplia*. On the other hand, it does not follow that *Racodiscula* is not a good genus, and with an amended definition it will be found adopted on a subsequent page.

Discodermia panoplia, n. sp. (Pl. XXXII. figs. 12–25).

Sponge (Pl. XXXII. fig. 12).—A small mass, with a broad, incrusting base, straight even sides ascending to an expanded summit, with well-rounded margin. Oscules several, small, occupying the summit of small conical elevations, situated in the upper surface of the sponge. Pores simple, singly distributed on the sides of the sponge.

Spicules.—I. Megascleres. 1. *Desma* (Pl. XXXII. fig. 13), of fairly regular tetrad form, with short, stout, cylindrical, simple or branched epactines, studded all over with tubercles (Pl. XXXII. fig. 14), which are either simply conical with rounded summits, or cylindrical, either with flat summits and rounded edges, or with expanded heads and secondary tubercles; zygosis takes place chiefly at the ends of the epactines or cladi, which are highly tubercular; the length of the epactine is usually about 0·16 to 0·24 mm., its thickness from 0·09 to 0·1 mm. Three of the actines of the axial rod usually differ in length from the fourth, which is longer; the three shorter are from 0·04 to 0·45 mm., the fourth and longer is from 0·84 to 0·9 mm. long.

2. *Discotriæne* (Pl. XXXII. figs. 15–19), a short conical rhabdome with rounded or pointed end, expanding distally into a more or less circular or cymbal-shaped cladome, with entire, sinuate, or lobate margins. The axial rod extends the whole length of the rhabdome, but its cladal processes do not proceed further than 0·019 to 0·026 mm. into the cladome. Rhabdome 0·045 to 0·10 by 0·02 mm.; cladome about 0·1 mm. in

[1] *Cf.* Zittel, *loc. cit.*, pp. 87, 88.

diameter when not lobate, lobes of lobate forms about 0·13 mm. in length, measured along a radius from the centre.

3. *Oxea*, fusiform, slender, sharply pointed, no complete forms observed, probably 0·75 mm. and over in length by 0·0195 mm. in diameter.

II. Microscleres. 4. *Microxea*, fusiform, smooth, straight or curved, sharply pointed, 0·07 to 0·1 by 0·0039 mm.

5. *Microstrongyle*, ellipsoidal or cylindrical, smooth; 0·01 to 0·015 by 0·0035 mm.

Colour.—In the dried state, brownish-white.

Habitat.—Station 192, off the Ki Islands, south of Papua, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud. Trawled.

Remarks.—The single specimen on which this species is founded presents an oval or somewhat ear-shaped, bilobed upper portion, 26 and 18 mm. in diameter; its maximum height is 18 mm. Scattered over the summit are some eleven or twelve small circular oscules, about 0·5 mm. in diameter. The pores are restricted to the sides of the sponge, and vary from 0·08 to 0·175 mm. in diameter. The subepithelial microstrongyles and microxeas cover the surface of the sponge, and extend through the pores and oscules over the walls of the underlying canals. The chief interest of the sponge lies in the ectosomal discotriænes, since owing to their complete preservation *in situ* one is able to arrive at a clear explanation of the diversity in form which these skeletal elements so constantly present throughout the "*Discodermia*" series. They occur within the ectosome in several layers, one above the other; the cyathiform triænes with entire margins are the most superficial, and are restricted in the specimens before us to the oscular surface; they extend up the sides of the oscular cones, and form the margins of the oscular apertures. Since the oscules are comparatively large, several of these discotriænes contribute to its marginal environment, and undergo no change of form in consequence (Pl. XXXII. fig. 23). It is otherwise with the triænes on the poral surface; the pores are small, and consequently are immediately surrounded by only few triænes, two to four, and the edges of these are adapted to the form of the pore, and thus one of the sinuses, it might be called the poral sinus, of the sinuous margin is produced. Sometimes the edge of the poral sinus is considerably thickened, and extended into an incomplete tubular form as an investment to the wall of the poral canal (Pl. XXXII. fig. 18).

The triænes which lie below the most superficial layer present numerous additional sinuses, and through each of these there passes the rhabdome of an overlying triæne. These might be known as the rhabdal sinuses. The rhabdal sinus of one triæne is frequently completed by that of another, or more than one other; a short circular tube is thus formed around the enclosed rhabdome (Pl. XXXII. fig. 22). Further complications arise from the fact that although many of the cladomes of the same layer are adjusted to

one another by overlapping, some on the contrary join by a true articulation, the edge of one being received between thickened outgrowths from the upper and under surfaces of its opponent (Pl. XXXII. fig. 19).

Though the rhabdome usually preserves its spicular character, yet there are instances in which it shares the fate of the cladi, either growing out into an expanded plate, and then exchanging the usual position normal to the surface for one of parallelism with it; or assuming other irregular forms and positions, as in fig. 18, where it has become bent up into the same plane as the disc, and curved and thickened to form what appears to be a small poral tube.

It is then by the adaptation of the cladomes to one another, and to the pores, that their sinuous outlines may be explained, and not on the assumption that they are passing into true desmas of the interior skeleton. Yet it is to be especially observed that the discotriænes differ from true spicules in much the same way as the desmas of the interior; at least this is true of the cladome, but not usually of the rhabdome. The axial rods of the cladi of the triæne spicule from which they arise cease to direct the formation of the cladome after a very early stage, just as the axial rods of the desma cease to influence the growth of the epactines; the cladomes then exhibit subsequently just the same power of adaptability as the desma, even to articulating together in a somewhat similar fashion.

Discodermia ornata, n. sp. (Pl. XXXI. figs. 1–6).

Sponge (Pl. XXXI. fig. 1).—Vase-shaped, with a short stout pedicel, expanding to an attached incrusting base; margins of the cup thin, rounded. The outer surface of the skeleton presents the open circular mouths of incurrent canals, irregularly dispersed, and shallow tubular grooves, which wander from the mouth of one incurrent canal to that of another, forming a superficial network; these grooves are the exposed subdermal cavities. The inner surface presents the mouths of the excurrent canals irregularly dispersed, they are largest and most closely clustered together at the base, where the vertical canals of the stalk open.

Spicules.—I. Megascleres. 1. *Desma* (Pl. XXXI. figs. 6, 6*a*–6*c*), usually of very regular tetrad form, with simple, or once or twice branched, cylindrical epactines, smooth, or covered with tubercles, which may be simply conical with rounded ends, or cylindrical with a flat summit and rounded edges, or cylindrical and dividing at the top into two or more smaller rounded or hemispherical tubercles. The ends of the cladi expand into tubercles, which adapt themselves to the ends or sides of neighbouring branches. The average length of the simple epactine is from 0·13 to 0·26 mm., of the epactine of cladose forms from 0·13 to 0·2 mm., the average diameter varies from 0·05 to 0·7 mm. The length of the axial rod differs within comparatively narrow limits from 0·052 to 0·071 mm.

2. *Discotriæne* (Pl. XXXI. figs. 5, 5*a*–5*d*), a short conical rhabdome, with a usually rounded end, expanding distally into a cyathiform cladome, with a circular, oval, or sinuous margin. The sides of the cladome extend forwards and outwards, forming a regular cone with an obtuse apical angle, or after extending outwards and forwards they may continue outwards only, forming a horizontally expanded brim. The axial rod extends throughout the rhabdome, but stops suddenly within the cladome at a distance of 0·032 mm. from its origin. Within the substance of the cladome fine granules, often concentrically arranged, are observable. Where the rhabdome enters the cladome, numerous fine radiating striæ occur, distinct from the axial rod (Pl. XXXI. fig. 5*c*). I am inclined to regard them as optical effects, due to the elongated appearance taken on by granules seen through the rhabdome as a conical lens.

3. *Oxea* (Pl. XXXI. figs. 2, 2*a*), long, slender, fusiform, tapering as though to a sharp point, but rounded off before reaching it; 0·8 by 0·008 mm.

II. Microscleres. 4. *Microxea* (Pl. XXXI. figs. 3, 3*a*, 3*b*), minute, fusiform, sometimes centrotylote, sometimes centroclinate, with pointed ends and finely granulated surface; 0·05 by 0·0039 mm.

5. *Microstrongyle* (Pl. XXXI. fig. 4), minute, ellipsoidal, or cylindrical with hemispherical ends, with a finely granulated surface; 0·0158 to 0·02 by 0·0039 mm.

Colour.—Of the skeleton white; remains of the dried skin yellowish-white.

Habitat.—Unknown.

Remarks.—The single specimen of this species is but the skeletal remains of the sponge, with a small patch of the dried ectosome incrusting the inner surface. It closely resembles *Discodermia calyx*, Döderlein,[1] but differs from it in the cyathiform character of the discotriænes; in this respect it resembles *Discodermia lævidiscus*, Carter,[2] but differs from it in general character, the latter being an incrusting sponge found on specimens of "*Melobesia*."

The present specimen is 66 mm. in maximum height, the cup is 35 mm. deep, 33 mm. and 43 mm. measured along its minor and major axes, and 4 mm. thick at its margin. The specific name "*ornata*" has reference to the highly ornate character of the desmas, produced by the rich development of tubercles by which they are usually studded all over. The tubercle commences as a conical process with a rounded end; by a lateral growth at two opposite sides it extends into a long rounded ridge which sometimes partially surrounds the epactines or cladi transversely; more usually it passes into a cylindrical form, and this may then develop secondary rounded tubercles at the end. The usual mode of zygosis of the desmas is by the ends of the apposed cladi, but some-

[1] Döderlein, Studien an japanischen Lithistiden, *Zeitschr. f. wiss. Zool.*, Bd. xl. pp. 64–104, pls. v.–vii., 1884.

[2] Carter, On Specimens Dredged up from the Gulf of Manaar, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vi. p. 149, pl. viii. fig. 51.

times the cladi may be seen applying themselves to the whole length of the epactine of an adjacent desma. The syzygial tubercles expand and adapt themselves to the attached surface in the usual fashion (Pl. XXXI. fig. 6*b*).

Genus *Neosiphonia*, n. gen.

Jereopsis, O. Schmidt, Spong. Meerb. Mexico, p. 20, 1879.

Tetracladidæ with a rounded body, supported on a longer or shorter stem; canal-system as in the fossil genus *Siphonia* or *Jerea*. The ectosomal megascleres are dicho- or tricho-triænes. The microsclere is a spiraster.

Schmidt states that ectosomal megascleres are absent in the specimens he examined, but he does not add whether these were fresh or deciduous examples. A fragment sent me by Professor Agassiz is certainly deciduous. If Schmidt's statement should be confirmed as true of fresh specimens, it would necessitate alterations in our classification; but since dichotriænes are associated with the species from Fiji, one would be surprised if they should prove to be absent in that from the Gulf of Mexico.

Neosiphonia superstes, n. sp. (Pl. XXXI. figs. 7–12).

Sponge (Pl. XXXI. figs. 7, 7*a*, 7*b*).—A somewhat spherical body, produced below into a short, stout, compressed pedicel, which ends without expanding into a base for attachment. Oscules collected in a somewhat depressed area on the summit, the patent ends of the excurrent canals, which descend into the sponge perpendicularly along the axis, but in a direction more and more parallel to the surface as they lie nearer to it. Pores (?). Small, circular holes scattered thickly over the outer surface of the sponge, including the pedicel, are the open ends of the incurrent canals, which are smaller than the excurrent, and enter the sponge perpendicularly to the surface, proceeding towards the centre along radial lines.

Spicules.—I. Megascleres. 1. *Desma* (Pl. XXXI. figs. 11, 11*a*). The four epactines, about 0·10 to 0·20 by 0·07 mm., bifurcate into cladi, some or all of which again subdivide once or oftener into smaller, irregular, twig-like branches. These end in syzygial tubercles, which apply themselves to the cladi or tubercles of adjacent desma, and unite with them by clasping and intergrowth in the usual manner (Pl. XXXI. figs. 12, 12*a*). Small cladi ending in tubercles are given off from the surface of the desma generally, except from the epactines, which are devoid of accessory processes as far at least as the extension of the axial fibre. The axial fibre extends from the centre through the epactines for a distance varying from about 0·065 to 0·16 mm., sometimes, but rarely, extending as far as the point of bifurcation, though in one or two instances it has been traced a little beyond it, bifurcating with the epactine, and extending as a

continuous rod for 0·026 mm. along one cladus, and for about the same distance as a row of granules along the other. Just before it terminates, for a distance of 0·019 to 0·026 mm., it loses its regular even-sided, rod-like appearance, and presents an irregular, wrinkled, or alternately swollen and constricted outline. The concentric layers of opal of which the desma is built up (both in this sponge and in the Lithistida generally) appear in optical section as a number of longitudinal lines parallel to the axial rod, but just beyond its termination they unite across in front of the end of the axis in curved lines, from which it is evident that in the course of development of the desma the axial rod not only ceased to lengthen with the growth of the epactines, but that immediately it did so it became closed in by the completion of the mineral part of the desma in front of it. The subsequent growth of the desma, its formation of cladi, twigs, and syzygial tubercles, takes place therefore entirely independently of the axial fibre. An axial portion, however, is still to be traced through the twigs and branches. It consists of silica of different refractive index and different solubility to the outer coatings, and runs as a wide core, about 0·005 mm. in diameter, bounded by undulating, longitudinal lines, and crossed by transverse curved lines up to the commencement of the apophyses. It reminds one of the axial core of the spongin fibres of horny sponges.

2. *Dicho-* or *tricho-triæne* (Pl. XXXI. figs. 10, 10*a*, 10*b*). A short, straight, conical rhabdome, with a rounded point, cladi bifurcate, or trifurcate, or irregularly subdivided, with rounded points, proto- and deutero-cladi extending in one plane at right angles to the rhabdome. Rhabdome 0·15 mm. long, protocladi 0·026 mm., deuterocladi 0·25 mm. long.

3. *Oxea* (Pl. XXXI. fig. 8), fusiform, with rounded points, 2·28 by 0·026 mm.

II. Microsclere. 4. *Spiraster* (Pl. XXXI. figs. 9, 9*a*), a short, thick spire, with long spines spirally arranged round it; total length 0·045 mm., length of spire 0·013 mm., of spines 0·032 mm.

Colour.—Unknown; the specimen consists only of the skeleton, which is snow-white.

Habitat.—Station 173, off Matuka, Fiji Islands, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; depth, 315 fathoms; bottom, coral mud. Dredged.

Remarks.—The single specimen dredged of this sponge consists merely of the skeleton, from which all the soft parts, except a few shreds of yellowish material, which appear to be parts of the skin, have disappeared. It is from this "skin" that the dermal triænes and spirasters described above were obtained.

The sponge is of extreme interest, since it represents in existing seas the *Siphoniæ* and *Jereæ* of the mesozoic era. With *Siphonia*, the first fossil Lithistid ever completely described and interpreted,[1] it agrees in all essential respects except, so far as one can judge from the broken character of the upper surface, in the absence of a deep central cloaca; in this respect it appears to resemble the genus *Jerea*, hence Schmidt's name

[1] Sollas, On the Structure and Affinities of the genus Siphonia, *Quart. Journ. Geol. Soc.*, p. 790, 1877.

Jereopsis, applied to an apparently similar sponge obtained from the Gulf of Mexico, in water from 80 to 90 fathoms deep.[1] Differences in detail, no doubt, exist between the desmas of the Fiji sponge and the Cretaceous *Siphoniæ;* in the latter they appear, for instance, somewhat smaller and not so freely branched as in the former. Such differences, however, are of no more than specific importance, and a generic distinction can only be maintained on the ground of our ignorance of some of the more important characters of the fossil forms, such for instance as the form of the microscleres and of the ectosomal megascleres. The dimensions of the sponge under description are as follows:—the total height is 46 mm., the diameter of the body 39 mm., the length of the pedicel is about 15 mm., the size of the base 23 by 10 mm.; the excurrent canals are 1·5 mm. wide near their distal ends; the incurrent canals 1 mm. and less where they commence at the surface.

Family II. Corallistidæ.

Triænophora in which the desma is monocrepid and tuberculated.

Genus 1. *Corallistes*, O. Schmidt.

Corallistidæ in which the ectosomal megasclere is a dichotriæne, and the microscleres are spirasters. The pores are simple.

Corallistes typus, O. Schmidt (Pl. XXXIV. figs. 14–18*a*).

Corallistes typus, O. Schmidt, Spong. Atlant. Gebiet., p. 22, pl. iii. fig. 3, 1870.
Corallistes bowerbanki (*pars*), Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 460, 1876.
„ „ „ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., p. 103, 1878.

Sponge (Pl. XXXIV. figs. 14, 15).—A thick transversely oval plate with well-rounded edges, erect, attached by an expanded incrusting base. Oscules small, somewhat numerous on the convex side. Pores dispersed over the concave side, singly perforating the poral areas. The rounded margin of the sponge is devoid both of oscules and pores.

Spicules.—I. Megascleres. 1. *Desmas* (Pl. XXXIV. fig. 16), these present the usual *Corallistes* form, and are studded with the characteristic capstan-shaped tubercles, as well as with simple conical and cylindrical forms; the ends are expanded to form foliated plate-like processes, which adapt themselves to the sides and ends of neighbouring desmas.

2. *Dichotriæne* (Pl. XXXIV. figs. 18, 18*a*), rhabdome short, conical, with rounded end; deuterocladi also with rounded ends, rhabdome from 0·238 to 0·32 by 0·032 mm., protocladi 0·02 mm., deuterocladi 0·116 mm. long. These spicules are of very various size, and the largest differ in the length of the rhabdome in different regions of the ectosome.

[1] O. Schmidt, Spong. Meerb. von Mexico, p. 20, pl. ii. fig. 10, 1879.

3. *Oxea*, long, slender, fusiform; occurring very sparingly, chiefly near the walls of the larger canals, to which they run parallel; the inner end of the spicule is sharply pointed, the outer has not been observed; more than 0·71 mm. in length by 0·004 mm. in thickness.

II. Microsclere. 4. *Spirasters*, these are mostly of the typical spiral form, but they vary almost indefinitely; the spire varies in form and dimensions, and the spines vary in both these characters and in number; sometimes the spines become much reduced in number, enlarged and produced into secondary spines, sometimes with an increase in size and reduction in number of the spines, the spire becomes thickened into a stout fusiform body, and variation in this direction may proceed so far that at length a minute fusiform centrotylote oxea, such as is represented by an accidentally unnumbered figure placed immediately above fig. 18. Pl. XXXIV., may be produced. The commonest form of spiraster is about 0·02 to 0·024 mm. long, with spines 0·005 mm. in length.

Throughout a great part of the ectosome a number of problematical hollow rods occur, thickly distributed, lying with their long axes variously orientated, but parallel to the surface; they consist of a thin siliceous shell, cylindrical in form, with rounded closed ends, hollow, and apparently empty within; 0·071 mm. long by 0·0065 mm. in diameter. As they are not present in all parts of the ectosome, and as they are quite unlike any known form of cylindrical sponge spicule, they can hardly be regarded as spicular components of the sponge; they may possibly be Diatoms like those met with in *Anthastra pyriformis* (p. 148).

Colour.—Yellowish-white.

Habitat.—Station 122, off Pernambuco, September 10, 1873; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Florida, 152 to 228 fathoms, and 7½ fathoms (O. Schmidt).

Remarks.—So far as one can judge from Schmidt's very imperfect description, the single specimen above described belongs to the species *Corallistes typus*, O. Schmidt. Schmidt's specimens were obtained from Florida at a depth of 152 to 228 fathoms, though one fragment was labelled 7½ fathoms, as Schmidt thinks by mistake. That which he figures closely resembles our sponge both in form and size; but certain irregularly bent uniaxial spicules which are represented as distributed through it are certainly not present in ours. These spicules, however, have probably been introduced, as Carter[1] affirms, by some parasitic sponge.

The Challenger specimen is 29 mm. in height, 35 mm. in width, and 13 mm. in thickness. The oscules, which are from 0·5 to 1·0 mm. in diameter, lead into excurrent canals, which immediately branch into the substance of the sponge; the pores lead into incurrent canals, which descend perpendicularly through the ectosome and open into longi-

[1] Carter, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xii. p. 443, 1873.

tudinal canals, which run either within the ectosome, or immediately below it; from these longitudinal canals, or sometimes without their intervention, but in direct continuation of the poral canals, others descend perpendicularly into the sponge, crossing the wall transversely, and traceable nearly as far as the oscular surface. The canals are crossed by vela, especially well marked near their origin.

The ectosome (Pl. XXXIV. fig. 16) is about 0·24 mm. thick over the oscular and poral faces, but at the margin of the sponge it increases to 0·48 mm. in thickness. It consists of ordinary collenchyma; in places, however, especially adjacent to the canal walls, containing numerous oval vesicles, from 0·02 to 0·028 mm. in diameter, empty of contents, except for the presence of a small spherical nucleus, 0·004 mm. in diameter, inclosing a minute spherical nucleolus. By the coalescence of several such vesicles a cavernous collenchyma is produced here and there. Besides the branching collencytes, the collenchyma contains small fusiform cells with long tails like those described in *Thrombus challengeri*.

The mesoderm of the choanosome is a sarcenchyma; it contains numerous amœboid cells irregularly dispersed through it, but most abundant near the ectosome. They stain more deeply with reagents than the surrounding tissue; their average diameter is about 0·03 to 0·04 mm., and they present, embedded in their granular protoplasm, an oval nucleus, 0·0158 by 0·0118 mm. in diameter, within which is a very evident deeply stained spherical nucleolus, 0·005 mm. in diameter.

The flagellated chambers are small, 0·0178 mm. long, by 0·0237 mm. broad; they are produced into a narrow aphodus which varies in diameter, measuring on an average about 0·0118 mm.

The development of the desmas follows the usual course, the young forms occur most numerously near the inner surface of the ectosome and about the walls of the canals; no clear evidence of a spicule cell was obtainable, though in two instances a flattened vesicle, containing a spherical granule and looking very like a nucleus with its nucleolus, was observed lying on the side of a young desma, the general surface of which was covered with a thin film of granular protoplasm. The nucleus, if it be such, measured 0·0158 mm. in diameter, the nucleolus 0·004 mm.

Corallistes masoni (Bowerbank) (Pl. XXXIV. figs. 1–13).

Dactylocalyx masoni, Bowerbank, Proc. Zool. Soc. Lond., p. 91, pl. vi. figs. 1–4, 1869.
„ „ Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 437, 1873.
Corallistes „ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 103, 1878.

Sponge (Pl. XXXIV. fig. 1).—An irregular flabelliform or folded, sometimes proliferating plate, with a rounded sinuous margin; erect, attached by an incrusting base. Surface smooth, even or dimpled. Oscules scattered on the inner face, situated on the

summits of little conical elevations. Pores dispersed on the outer face, singly and centrally perforating a poral area.

Spicules.—I. Megascleres. 1. *Desma* (Pl. XXXIV. figs. 7, 8), various in form, branches short, expanded at the ends, bearing simple and compound tubercles, the latter with a cylindrical stem and an expanded hemispherical head, raised into low rounded secondary tubercles. The epirabd of a simply curved desma measures on the average 0·6 by 0·052 mm.; the branches of complex forms are about 0·024 to 0·032 mm. long; the larger tubercles 0·039 to 0·045 mm. wide across the head.

2. *Dichotriæne* (Pl. XXXIV. figs. 2, 2*a*), rhabdome straight, conical, rounded off at the end; protocladi extending outwards and forwards, deuterocladi horizontal, frequently slightly recurved close to the end, which is rounded off. Rhabdome 0·75 by 0·039 mm., protocladi 0·026 mm., deuterocladi 0·155 mm. long. These spicules, as observed by Bowerbank, differ greatly in size, even when fully grown. The largest measured by Bowerbank is stated to be $\frac{1}{38}$ inch (0·658 mm.) long, with a chord of $\frac{1}{80}$ inch (0·31 mm.), dimensions very nearly those of the longest spicule observed by me, of which measurements are given above.

3. *Oxea*, long, slender, cylindrical, or fusiform, sharply pointed, simply curved or sinuous, 0·92 by 0·007 mm. These spicules are arranged to form fibrous groups, which near the surface lie parallel with the shafts of the dichotriænes.

II. Microsclere. 4. *Spiraster* (Pl. XXXIV. fig. 12), a spiral axis, with spirally arranged spines, 0·02 to 0·024 mm. long, spines 0·004 mm. long. This spicule occasionally passes into an amphiaster, 0·27 mm. long, with spines 0·0118 mm. long; or sometimes even into minute quadriradiate or triradiate plesiasters, like the corresponding spicules of *Thenea*; the spines of these modifications are about 0·014 mm. long.

Colour.—Yellowish-white.

Habitat.—Porta Praya, St. Iago, Cape Verde Islands, August 1873; depth, 100 to 128 fathoms.

Madeira (Bowerbank).

Remarks.—Bowerbank gives an excellent description of this sponge, taken from a remarkably fine specimen, much larger than any which have passed through my hands. The Challenger specimens are indeed all fragments, with the exception of one small and evidently young form, which is fairly complete. This is somewhat fan-shaped, about 38 mm. by 30 mm. in length and breadth, and 23 mm. high; the thickness of the plate is about 6 to 7 mm. The base, which is well preserved, is slightly expanded. The largest fragment (Pl. XXXIV. fig. 1) bears oscules on the convex side of the two attached plates of which it consists; these plates, however, are bounded by broken edges, and so joined at the base as to suggest that they form parts of a single fold, and if this be so, as I do not doubt it is, the oscular faces would have formed the inner surface of the fold when

complete. The margins of the plates are incurved towards the poral faces, rendering them more concave than they would otherwise be. Where the oscular faces of two plates have come in contact in course of growth, they have grown together. The height of this fragment is 75 mm., the thickness of the plate from 8 to 10 mm. Bowerbank's specimen, with a height of 188 mm., presents a thickness of from 10·5 to 12·5 mm.

Most of the specimens illustrate in a very striking manner the local death to which sponges, and especially Lithistid sponges, are liable; the greater part of some of the fragmentary plates consists of dead skeleton, the remainder of complete and apparently healthy sponge. In one case the wall having everywhere decayed around a circumscribed patch which still remained alive, the latter, prevented from extending laterally, has increased in thickness, so that it is 1 mm. thicker than any of the normally grown specimens with which it is associated, and, of course, much thicker than the rest of the plate to which it belongs.

The whole exterior surface of the sponge is invested with an epithelium, on the under surface of which spirasters are thickly scattered. In a tangential section one sees below this the cladomes of the dichotriænes, with the cladi of various sizes extended in every direction, and not regularly mapping out poral areas, as is the case with many other sponges provided with similar spicules. Between the cladi, often in the angle of the deuterocladi, tubercular processes are seen extending directly upwards from the underlying desmas. On the oscular surface the dichotriænes extend up the sides of the oscular cones, but do not proceed far beyond the margin of the summit, which is usually from 0·4 to 0·5 mm. in diameter, and bears in the centre the oscule, which is from 0·1 to 0·3 mm. in diameter. The epithelium, with its associated spirasters, extends across the annular space which separates the oscule from the desmas, and is continued downwards as a lining to the excurrent tube. On the poriferous surface the desmas are absent from numerous special areas, each of which is perforated in the centre by a single pore, from 0·02 to 0·06 mm. wide; sometimes no poral aperture can be distinguished, the position of the pore, however, remains clearly indicated by what appears to be a dense aggregation of spirasters; this is, however, an optical delusion, due to one's looking down into the poral canal, the sides of which are covered with spirasters underlying the epithelium. The dichotriænes are not regularly arranged around the poral area, and their cladi do not extend quite close to its margin.

The ectosome (Pl. XXXIV. fig. 13) is about 0·8 mm. thick on both faces of the sponge. It consists of a gelatinous matrix full of round or oval empty vesicles, from 0·02 to 0·0316 mm. in diameter; occasionally a small quantity of granular protoplasm is seen investing a part of the interior of the vesicle, and within this, bulging it out on one side, is a spherical or oval vesicle, about 0·004 mm. in diameter, containing a central granule, together resembling a nucleus with its nucleolus. In other cases several little bodies, reminding one of choanocytes, are seated on the wall. They consist of a basal

spherical part, from which a narrow, cylindrical neck projects into the interior of the cavity, the length of the whole structure being 0·0118 mm.

The vesicles are frequently crowded together so as to reduce the matrix to very thin partitions (Pl. XXXIV. fig. 12). Numerous granules are dispersed through the matrix, and it takes a distinct stain with hæmatoxylin; branching and fusiform collencytes, with nuclei like those seen within the vesicles, are also present. The tissue is therefore a collenchyma containing vesicular cells, similar to those which occur in *Pleroma* and other Lithistids. The vesicular cells are, I am inclined to think, residual cells, developed from smaller but similar cells, which are scattered through the matrix, and which can be traced downwards to a size not exceeding 0·008 mm. in diameter. It appears possible that they may have been filled when fresh with some kind of oil, since in *Pachymatisma*, which possesses similar cells, multitudes of oily globules immiscible with water, are set free on cutting through the cortex. If this oil were soluble in alcohol, the oil-bearing cells in spirit specimens would resemble the vesicular cells above described. The choanosome is distinguished from the ectosome, partly by the presence of flagellated chambers, partly by the character of the mesoderm, which consists of sarcenchyma. There is no sharp line of demarcation between the two regions, however, and vesicles precisely similar to those of the ectosomal tissue extend from it for some distance into the sarcenchyma. The sarcenchyma also contains numerous problematical little bodies, as much as 0·004 to 0·005 mm. in diameter, subangular in outline, apparently homogeneous, and very darkly stained by hæmatoxylin. The flagellated chambers (Pl. XXXIV. fig. 10) are small, about 0·024 to 0·031 mm. broad, by 0·018 to 0·024 mm. long; they open into narrow aphodi, and are supplied by short, wide prosodi. The choanocytes present comparatively large, deeply stained, basal portions, about 0·0035 mm. wide by 0·004 mm. long, the collum appears to present double-contoured walls, and ends in the usual fenestrated diaphragm; the total length of the choanocyte is 0·012 mm.

Formation of the Desma (Pl. XXXIV. figs. 3–6).—In slices cut from specimens frozen in gelatine jelly, several young desmas are seen lying close to the outer epithelium bounding the ectosome. They are granular throughout, and are separated from the surrounding collenchyma by an interval which is partially filled by dark, granular, deeply-stained protoplasm, forming an incrusting layer 0·009 mm. in thickness, and containing oval nuclei 0·008 mm. in length, with spherical nucleoli. This darkly-stained material is in striking contrast to the surrounding collenchyma, and evidently associated with the young desmas, so that I am inclined to regard it as representing a layer of scleroblastic cells.

Corallistes thomasi, n. sp. (Pl. XXXV. figs. 12, 13; Pl. XV. figs. 40–46).

Sponge (Pl. XXXV. figs. 12, 13).—A small, somewhat ear-shaped plate, margin rounded, erect, attached by an incrusting base. Oscules numerous, small, with raised margins, scattered at nearly equal distances apart over the convex face of the plate (Pl. XXXV. fig. 13). Pores scattered evenly on the concave side of the plate (Pl. XXXV. fig. 12), each porous area singly perforated by a central circular pore.

Spicules.—I. Megascleres. 1. *Desma*, epirabd stout, cylindrical, cladi similar, rather short, bearing somewhat stud-shaped tubercles, presenting a short, cylindrical stalk or neck, which terminates in an expanded, somewhat hemispherical head, about 0·032 to 0·064 mm. in diameter, bearing low, rounded, secondary tubercles, arranged in groups, those on the sides being frequently elongated longitudinally. The ends of the cladi terminate in expanded lobate processes, which grow over the sides of neighbouring desmas, closely embracing the necks of the tubercles. The breadth of the cladi is usually about 0·045 to 0·052 mm., their length 0·065 to 0·097 mm.

2. *Dichotriæne* (Pl. XV. figs. 40–42), rhabdome stout, short, conical, strongylate; protocladi relatively very short, deuterocladi long; both spreading horizontally, bearing on their distal face short, rounded, conical tubercles which project forwards, growing out into tubercles at the edges also. Rhabdome 0·366 by 0·039 mm., often 0·013 mm. wide at the end where rounded off, protocladus 0·0194 by 0·032 mm., deuterocladus 0·084 by 0·026 mm.

II. Microscleres. 3. *Strongylospire* (Pl. XV. fig. 43), undulating or vermiculate rods, axis straight, curved, or irregularly bent, 0·026 to 0·032 by 0·004 mm.

4. *Spiraster* (Pl. XV. figs. 44–46), of various forms, approaching the metaster and amphiaster types, 0·032 mm. long, a single spine from 0·008 to 0·016 mm. long.

5. *Orthotrichites;* scattered amongst the spicules obtained by boiling out with nitric acid on the glass slide, are fine siliceous filaments distinctly double-contoured, but too fine to afford measurements of thickness, sharply pointed at each end, and about 0·16 mm. long.

Colour.—In the dried state yellowish-white.

Habitat.—Station 192, off the Ki Islands, south of Papua, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud.

Remarks.—This specimen so closely resembles in form and size another belonging to a different genus and species, *Azorica marginata*, obtained at the same station, that they were originally mistaken for one another, and the whole sponge of *Corallistes thomasi* was figured along with the desmas of *Azorica marginata*.

The present sponge is about 16 mm. wide, 11 mm. high, and 4 mm. thick. The oscules occur as central perforations about 0·048 mm., at the bottom of circular craters,

about 0·16 to 0·24 mm. in diameter, situated at the summit of conical monticules, about 1·0 mm. wide at the base. The ectosomal dichotriænes extend over the sides of the monticules, but stop short at the summit; the interior of the crater is lined by the strongylospires and associated spirasters, which lie beneath a thin outer skin. This spicular layer is continued down the sides of the tube, which descends into the sponge from the oscule.

The poral tubes are each surrounded by a skeletal wall formed of desmas, and end at the surface each in a little crateriform depression, lined by a spicular layer like that of the oscules. The pore is simply the open end of the poral tube; it is usually about 0·032 mm. in diameter, and the depression in which it lies about 0·16 mm. across.

The dichotriæne recalls to mind that of *Corallistes noli-tangere*, as figured by Schmidt. Zittel's illustration of this spicule differs from Schmidt's, and is altogether unlike that of *Corallistes thomasi*. The strongylospire is the homologue of the microrabd which occurs in other species of *Corallistes*, it is possibly not truly spiral, but merely undulating, and if so, should be termed a sinuous strongyle.

Corallistes bowerbanki, Johnson.

Dactylocalyx bowerbanki, Johnson, Proc. Zool. Soc. Lond., p. 257, 1862.
" " Bowerbank, Proc. Zool. Soc. Lond., p. 94, pl. vi. figs. 5–8, 1869.
" " Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. pp. 437, 441.
Corallistes bowerbanki, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 460, 1876.
Corallistes typus, Zittel, Abhandl. d. k. baier. Akad. d. Wiss., vol. i. pp. 103, 120, 1878.

The specimen, which I believe I am right in assigning to this species, is but a part of the wall of a sponge which in the complete state must have been of very considerable size. It had evidently been lying in a dead state on the sea-floor for a long time before it was dredged up, consequently microscleres are not present, and the ectosomal triænes have suffered considerably from solution. The fragment is a plate-like slab, bounded by broken edges on two sides, and on the third by the natural margin, which is not rounded but irregularly ridged. It measures 96 by 112 mm. and is 16 mm. thick. On the poral surface exposed superficial canals are seen with a general longitudinal drift towards the margin. Both excurrent and incurrent canals, which are about 0·5 mm. wide, wander crookedly but transversely through the wall.

The desmas differ markedly from those of *Corallistes masoni*, Bowerbank, they are usually smooth, tubercles only appearing here and there on the sides of the epirabds and cladi, which end by breaking up into numerous twig-like processes with expanded ends. The interlocking of the desmas takes place by means of these processes, and in general character much resembles that of the Tetracladidæ; the quadriradiate form of some of the desmas is also very striking, but all are founded on a monaxial spicule.

The ectosomal spicules are dichotriænes, the conical rhabdome measures 0·72 by

0·032 mm., the protocladi 0·05 mm., the deuterocladi 0·223 mm. in length. In one instance a dichotriæne entangled in the skeleton was observed with tuberculated cladi.

Habitat.—Coast of Portugal.

Deep water off Madeira, Johnson; near Cape St Vincent, 374 fathoms, "Porcupine" Expedition (Carter).

Remarks.—Zittel regards *Corallistes bowerbanki*, Johnson, and *Corallistes typus*, O. Schmidt, as identical species; the difference by which they are most readily distinguished is the size of the dichotriæne, the rhabdome of which has in *Corallistes bowerbanki* twice or three times the length of that in *Corallistes typus*. In this respect the former species more closely resembles *Corallistes masoni*, from which it is distinguished by the far greater thickness of its sponge wall, as well as by the characters of the desmas.

Genus 2. *Callipelta*, n. gen.

Corallistidæ in which the ectosomal megasclere has the form of a discotriæne, but the axis of a rhabdus. The microsclere is an amphiaster.

Callipelta ornata,[1] n. sp. (Pl. XXXVIII. figs. 28–30).

Sponge.—At an early stage hemispherical, bearing a single oscule at the end of a tubular prolongation; attached.

Spicules.—I. Megascleres. 1. *Desma*, of the usual *Corallistes*-form, bearing tubercles with cylindrical necks and expanded heads, subdivided into a few large, rounded, secondary tubercles; crepidial axis, centrotylote, 0·02 mm. long.

2. *Discostrongyle* (Pl. XXXVIII. figs. 28, 29), rhabdome short, stout, conical, strongylate, frequently produced into a few conical, rounded tubercles, or branching lamellar outgrowths at the strongylate end, expanding distally into a horizontal disc, with an incised, somewhat crenate or bicrenate margin, and tuberculate distal surface. The tubercles are of a rounded, conical form, scattered at about equal distances apart. The discs partly overlap, partly are articulated together by their denticulated margins. Rhabdome 0·028 to 0·045 by 0·016 to 0·02 mm., from 0·008 to 0·012 mm. thick at the strongylate end, disc 0·1 by 0·14 to 0·11 by 0·18 mm. in breadth and width, 0·012 mm. thick, tubercles about 0·008 mm. apart.

3. *Oxea*, slender, cylindrical, over 0·16 mm. long by 0·002 mm. in diameter.

II. Microscleres. 4. *Amphiaster* (Pl. XXXVIII. fig. 30), axis short, straight, cylindrical, with a whorl of spines at each end, and also at each end a single spine prolonging the direction of the axis; occasionally spirally arranged spines appear on

[1] This is named *Corallistes callipelta* on the legend to the Plate.

the sides of the axis, spines slender, conical, terminally tylote; axis about 0·006 mm. long, spines about 0·008 mm. long, total length of amphiaster 0·02 to 0·024 mm.

Colour.—Yellowish-white in the dried state.

Habitat.—Station 192, off the Ki Islands, south of Papua, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud.

Remarks.—This little sponge, only about 2 mm. in diameter, was found incrusting the fragment of limestone to which *Corallistes thomasi* is attached. It might easily have been mistaken for a Foraminifera, but on mounting in balsam its true character at once appeared.

The monocrepidial character of the desma is obvious enough at all stages of its development from the earliest to the latest, but the nature of the disc does not at first appear so clear. After a searching examination I can find no trace of a division of the rhabdal axis on or after entering the disc, there is no trifid nor any other subdivision, simply an abrupt and sudden termination. No trace of subdivision was revealed by treatment with hydrofluoric acid. The disc therefore is uniaxial, like that of *Neopelta*, from which, however, it differs not only by the tuberculation of its surface and the denticulation of its margin, but also by the almost constant presence of a stalk. Only in a single instance was the rhabdome not observed, and even then its place was indicated by a slight irregularity of the surface, and no tangentially lying crepidial axis was observed. In *Neopelta* the stalk on the contrary is more often absent than not. In addition to this the stalk is usually at right angles to the disc in *Callipelta*, while in *Neopelta* when present it is usually obliquely inclined. The discostrongyle of *Callipelta* appears therefore to form a connecting link between the discotriæne and the disc, it differs from the latter and resembles the former in the almost constant presence of a stalk set at right angles to the disc; it differs from the former and resembles the latter in the constant absence of cladal axes. The question then arises, so difficult to answer in all similar cases, not only in the Lithistidæ, as to whether the disc is descended from the discotriæne, or *vice versâ*, or whether both have a separate or a common third origin. The last alternative may I think be safely dismissed. With regard to a separate origin there is more to be said. The discotriæne can be traced into the dichotriæne, and we may safely assert that one has arisen from the other. The dichotriæne is the most widely diffused, and departs the least from the usual spicular type, so that the order of development has in general been tacitly assumed as from the dichotriæne to the discotriæne, and not *vice versâ*. This conclusion becomes strengthened when the identity in character of the dichotriæne in the Lithistidæ with that of the Choristidæ is considered. Zittel, indeed, speaks of the resemblance between these spicules in the two groups as a deceptive or false resemblance; this is mere transcendentalism, false conclusions may be drawn from the resemblance no doubt, but the resemblance itself

is real enough; I doubt whether any one, including Professor Zittel himself, could distinguish the dichotriænes of some Lithistida from those of some Choristida, even under the highest powers of the microscope. In the general introduction we have shown reasons for regarding the Lithistida as derived from the Choristida, and not *vice versâ*, and connected with this is the probability that the dichotriæne is a part of the Lithistid inheritance from the Choristida. Thus then we may regard the discotriæne as a modified dichotriæne, and not *vice versâ*. If now we consider the disc, it may have been derived from the discotriæne, or independently evolved. Thus in *Scleritoderma*, to which the suggestion of being a parental, rather than a filial form is given by the presence of sigmaspires, we find strongyles very similar to the crepides of the monocrepidial desma accumulated to form a subdermal skeletal layer. The tendency amongst the Lithistida for spicular structures lying near the surface of the sponge to grow out in a plane parallel to it is exemplified by the broadening of the cladi of the dichotriæne, by which it becomes converted into the discotriæne. If the same tendency should affect the strongyles lying beneath the epithelium in *Scleritoderma*, they would become converted into discs like those of *Neopelta*; if some of these strongyles lie obliquely not quite parallel to the surface of the sponge, we may expect the distal end alone to expand, and then the discs with oblique stalks, also characteristic of *Neopelta*, would arise. Thus a separate origin for the *Neopelta*-disc is quite conceivable, and the explanation just given accounts for the position of the crepidial axis in the plane of the disc, a feature very difficult to understand on the hypothesis that the discs are modified discotriænes.

But next we have to consider the relationship of the discostrongyle of *Callipelta*; in the fact that the shaft is nearly always directed at right angles to the disc, and that the crepidial axis never lies in the plane of the disc, even when the shaft is absent, this much more closely resembles a discotriæne than a disc; the desmas of *Callipelta* are also much more like those of *Corallistes* than of *Neopelta*, and I think we may with greater probability regard the discostrongyle as a reduced discotriæne than as a modified disc. This being so the issue is much narrowed, and the only point for inquiry which remains is as to the relation of the discotriæne series (inclusive of the discostrongyle) to the *Neopelta*-disc. Is the latter a reduced discostrongyle, or of separate origin, or is any third explanation possible? I must confess that to me it is difficult to answer the first part of the question in the affirmative, an affirmative to the second one would avoid if one could, and a third explanation may be suggested. Instead of regarding the completed disc, let us fix our attention on the crepis; in the dichotriæne this is of course a dichotriæne, in the discotriæne it is frequently reduced to an orthotriæne; the general superficial extension of the cladome being independent of the direction of the deuterocladal axes, the existence of these ceases to have any meaning, and they disappear as useless structures; but the protocladal axes are also useless, and they similarly but subsequently

disappear, they are of very variable size even in the spicules in which they are constantly present, frequently reduced to 0·004 mm. in length, and their disappearance as in the discostrongyle need cause us no surprise. A reduction, in this case more readily intelligible than in many others, has taken place of a precisely similar character to that which produces a microxea from a spiraster or an oxyaster. The crepis, now become monaxial, is liable to an independent series of modifications, and no longer compelled into a definitely orientated position by the presence of cladal axes, assumes a position partly tangential, partly radial, and partly intermediate or oblique, the disc-like expansion is produced by the same tendency as existed before, and discs result in which the crepis may lie either wholly immersed, or only partially, as in *Neopelta*. But the existence of the discs themselves is no longer necessary with the changed position of the crepides, and so in *Scleritoderma* we find lying beneath the epithelium merely a felt of strongyles altogether tangentially arranged. Thus owing to the changes in the structure of the adult spicule working their way backwards till they affect the embryonic spicule or crepis, fresh series of changes are evoked which lead to fresh series of modifications in the adult. This hypothesis serves to connect the dichotriænes of *Corallistes* with the strongyles of *Scleritoderma*; but it is purely a hypothesis, and in view of the presence of sigmaspires in the last-named genus, the possibility that it may be an advancing and not a reduced form must be carefully borne in mind.

Family III. Pleromidæ.

Triænophora in which the desma is monocrepid, and smooth, not tuberculated; zygosis is produced by the expanded ends of the cladi of one desma clasping the sides of the epirabd or cladi of another.

Genus 1. *Pleroma*,[1] n. gen.

Pleromidæ in which the flagellated chambers are large, with wide, short aphodi. The microscleres are microxeas and spirasters.

Pleroma turbinatum, n. sp. (Pl. XXXIII.).

Sponge (Pl. XXXIII. figs. 1–2).—Small, obconic, compressed, terminating below in a small, short, rounded pedicel, upper surface slightly convex, depressed in the middle, margin rounded, oscules small, confined to the upper surface, the simple openings of narrow vertical canals. Pores simple, generally distributed over the sides.

Spicules.—I. Megascleres. 1. *Desma* (Pl. XXXIII. figs. 7–7*e*); this consists of a

[1] πλήρωμα, τό, a full measure, complement; in allusion to the presence of a full complement of spicules.

straight, curved, or sinuous, more or less cylindrical epirabd, varying from 0·2 to 0·5 mm. in length, and from 0·05 to 0·09 mm. in breadth; produced laterally and terminally into a variable number of simple or bifurcate cladi, terminating in lobate or saddle-shaped expansions, which clasp the epirabd of adjacent desmas (Pl. XXXIII. fig. 8*f*). The crepis (Pl. XXXIII. figs. 8, *d*, *d'*) is a cylindrical strongyle, about 0·065 by 0·001 mm. in length and breadth, traversed by an axial rod about 0·04 mm. long. The successive coatings of opal deposited on this can be traced by successive alternating layers of clear and granuliferous opal, the outermost layer being always clear (Pl. XXXIII. fig. 8*e*).

The history of the desma thus recorded exactly corresponds with that obtained by piecing in a series desmas in successive stages of development.

In the young adult desma the cladi terminate in slender finger-like processes; these, applying themselves to the shaft of a neighbouring desma, grow over it in expanded lobate ends, thus producing the clasped zygosis already described.

The total length of the adult desma varies from about 0·5 to 0·8 mm.; the length of the epirabd seldom exceeds 0·18 mm.

2. *Dichotriæne* (Pl. XXXIII. fig. 3). This precisely resembles the corresponding spicule of the Choristida; the rhabdome is conical, straight or curved, much tapered proximally, but usually ending in a rounded-off point; the protocladi extend outwards and forwards, the deuterocladi outwards, terminating in rounded points. An axial rod extends throughout both rhabdome and cladome. Rhabdome 0·96 by 0·04 mm., protocladi 0·064 mm., deuterocladi 0·16 mm. long. The cladome lies beneath the outer epithelium, the rhabdome descends perpendicularly into the interior (Pl. XXXIII. fig. 9).

3. *Oxea* (Pl. XXXIII. fig. 4), slender cylindrical, curved or somewhat sinuous, tapering to a sharp end with rounded-off point, usually thicker towards the distal end, 1·35 by 0·008 mm. This spicule is chiefly confined to the ectosome, which it traverses radiately, projecting beyond the surface, which it thus renders hispid; but a few straggling examples are also to be met with in the choanosome.

II. Microscleres. 4. *Microxea* (Pl. XXXIII. fig. 5), fusiform, surface often minutely roughened, frequently centrotylote, sharply pointed, about 0·18 to 0·213 by 0·005 mm. This spicule corresponds to the microxea of *Pœcillastra*.

5. *Spiraster* (Pl. XXXIII. fig. 6), a somewhat cylindrical spire, with a helical twist of four to six revolutions; produced into spines at right angles to the surface, one at every quarter or half revolution, and into two or three spines at the end; spines sometimes suppressed over a great part of the spire; length of the spines variable, sometimes as much as 0·005 mm. A single amphiaster was observed amongst the spirasters, evidently resulting from modification. Total length about 0·024 to 0·03 mm.

Colour.—Light grey externally, within light brown.

Habitat.—Station 173, off Matuku, Fiji Islands, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; depth, 315 fathoms; bottom, coral mud. Dredged.

Remarks.—This little sponge, 11 by 10 mm. in diameter, and 10 mm. high, is the only representative of Zittel's Megamorina in the Challenger collection. The family is chiefly known in the fossil state; only one existing species has been described previously to this, and that—*Lyidium torquila*, O. Schmidt—evidently belonging to a different species, or, if the published descriptions are complete, to a different genus, and perhaps family, since it is represented as not possessing triænes, microxeas, or spirasters.

Owing to the precious nature of the small amount of material I had at my disposal, I could not make quite so searching an investigation as I could have wished; at the same time, few points capable of determination have been left obscure. Most doubtful are the characters of the oscules and pores, but such few apertures as I did find of either kind were small, simple, and circular, not sieve-like.

The ectosome (Pl. XXXIII. fig. 9), about 0·6 mm. in thickness on the upper surface of the sponge, consists of a tender collenchyma containing numerous round or oval hollow cells, 0·02 to 0·023 mm. in diameter, with thin structureless walls and scanty granular protoplasmic contents, not taking a deep stain with reagents. A circular or annular nucleus, 0·004 mm. in diameter, lies embedded in the protoplasm, which is vacuolated.

The illustration (Pl. XXXIII. fig. 13) shows these cells in the collenchyma immediately beneath the outer epithelium; the wash of brown colour represents the collenchymatous matrix, which is not a solid mass as this would seem to suggest, but cavernous. The microxeas form quite a felt about the subdermal canals, much in the same fashion as in *Pœcillastra* (Pl. XXXIII. fig. 9).

Choanosome.—The mesoderm, except in the vicinity of the larger canals, where it becomes collenchymatous, is a richly granular sarcenchyma, which takes a deep stain with reagents. Numerous small round or oval cells, 0·02 mm. in diameter, with a nucleus 0·005 mm. in diameter, and resembling the vesicular cells of the ectosome, occur dispersed through it, each cell lying within a little cavity, produced no doubt by treatment. Sometimes these cells, instead of presenting a faintly stained protoplasm surrounding a thin structureless wall, are wholly composed of protoplasm which takes an unusually deep stain. In some cases a number of little, transparent, structureless, somewhat highly refractive, globules are seen surrounding the margins of both the deeply and faintly staining cells; they look somewhat like oil drops (Pl. XXXIII. fig. 14). Of their real nature I am ignorant. The flagellated chambers are large, 0·044 mm. wide by 0·04 mm. long, almost spherical, provided with a wide prosopyle, 0·02 mm. in diameter, and an also wide apopyle, 0·0237 mm. in diameter, which leads into an aphodus frequently as wide as it is long, sometimes, for instance, measuring 0·0275 mm. in both directions (Pl. XXXIII. fig. 10).

The choanocytes are large, frequently 0·0118 mm. in length, and sometimes nearly 0·004 mm. in diameter at the base. The collar or collum, I am not rightly sure which

(Pl. XXXIII. figs. 11, 12), is continued into the fenestrated membrane, which crosses the aphodal face of the chamber, as in nearly all Tetractinellida; it is here very conspicuous, so that I first discovered its existence in this sponge.

The fenestræ are round or oval, and from 0·004 to 0·006 mm. in diameter; sometimes a small, round, deeply stained body is seen occupying their centre. This appears to me to be the body of one of the choanocytes detached from the wall of the chamber, and drawn by the contraction of the collum into the middle of the fenestra.

Coating the desmas of the skeleton is a thin lamella, which stains with hæmatoxylin; it is to be frequently met with detached from both the desma and the surrounding sarcenchyma. It appears to be fragile, breaking readily into polygonal fragments. It was eagerly searched for associated cellular elements or scleroblasts, but as a rule no structure of any kind could be discerned in it. In a few instances, however, the appearances represented in the illustrations (Pl. XXXIII. figs. 15, 15*a*-*d*) were observed; they were so rare and exceptional, however, that I hesitate to attach any importance to them. That the lamella is in some manner connected with the formation of the desma appears however to admit of little doubt, and it is just possible that it may represent an exudation from surrounding but hypothetical scleroblasts that has since become hardened by treatment. It is also possible that the lamina represents a stratum of organic matter destined to receive a deposit of silica, and so to add to the thickness of the desma, and in this case the apparent cellular structures associated with it may be exhausted scleroblasts, though, judging from the homogeneous nature of the outer layers of the desma, this seems unlikely.

Demus II. Rhabdosa.

Hoplophora in which the ectosomal spicules are microstrongyles or modified microstrongyles (discs). The desmas are monocrepidial.

Family II. Scleritodermidæ.

Rhabdosa in which the ectosomal spicules are microstrongyles, and the other microscleres sigmaspires.

Genus 1. *Scleritoderma*, O. Schmidt.

Scleritodermidæ of plate-like form, bearing simple oscules on one face, and simple pores on the other.

Scleritoderma flabelliformis, n. sp. (Pl. XXXV. figs. 26–50).

Sponge (Pl. XXXV. figs. 26–28).—Small, irregularly flabelliform, margin rounded, sinuous, lobate, usually pedicellate, attached by an expanded incrusting base. Oscules numerous, small, the open ends of monticular or short tubular elevations, proceeding from the front and usually concave face of the sponge. Pores on the opposite face, the open ends of little tubular elevations, similar to, but slightly smaller than those bearing the oscules, arranged in sinuous rows, or scattered singly.

Spicules.—I. Megascleres. 1. *Desmas* (Pl. XXXV. figs. 43–49), presenting the various irregular forms characteristic of the monocrepid desmas. When elongated chiefly in one direction they may attain a length of 0·4 to 0·5 mm., when quadriradiate a single branched cladus may measure 0·24 mm. in length, the average breadth of the epirabd is about 0·039 mm.

The young desma (Pl. XXXV. figs. 34–41) in its earliest observed stage is a cylindrical strongyle with an eroded surface; it is 0·0774 mm. long by 0·015 mm. wide, and presents an axial rod traceable for 0·045 mm. The crepidial axis of the adult desma is traceable for a distance of from 0·032 to 0·045 mm.

II. Microscleres. 2. *Microstrongyle* (Pl. XXXV. figs. 29–33), a thin membrane invests the sponge, and is accompanied by a layer of microstrongyles one or two deep, lying parallel to the surface in various directions, and so close together as to form a kind of felt. These spicules are fusiform or cylindrical, with rounded, or slightly and spherically enlarged ends, straight, simply curved, or irregularly bent, with a roughened or minutely granulated surface; about 0·08 to 0·09 by 0·013 mm.

3. *Sigmaspire*, of the usual form, varying from less to a little more than a single revolution, 0·01 mm. in length.

Colour.—In the dried state the surface has a faint yellowish-brown tint.

Habitat.—Station 192, off the Ki Islands, south of Papua, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud. Trawled.

Remarks.—Of this sponge five specimens were trawled. The smallest, which is the most perfectly flabelliform, is 19 mm. high, 12 mm. broad, and 3 mm. thick; the largest two measure respectively 42 mm. by 23 mm., and 20 mm. by 34 mm. in height and breadth; though usually pedicelled, the sponge is sometimes in its most irregular and incurved form, attached by the convex side of the folded plate.

The successive stages in the development of the desma are to be readily followed, owing to the abundance of young forms; they are illustrated in Pl. XXXV. figs. 34–42. A description of the development of the monocrepid desma generally is given in the Introduction.

The resemblance of this sponge to *Scleritoderma packardi* is very close, the characters of the pores and oscules are similar, and the same kinds of spicules are present in both; the specific distinction is well marked, resting not only on the difference in external form, though this is considerable, but more particularly on the dimensions of the microstrongyle, which is twice the length in *Scleritoderma packardi* of that in *Scleritoderma flabelliformis*.

Family II. Cladopeltidæ.

Rhabdosa in which the ectosomal spicule is a desma highly branched in a plane parallel to the surface. Microscleres are absent.

Genus 1. *Siphonidium*, O. Schmidt.

The oscules are the simple terminations of narrow external tubular processes.

Siphonidium capitatum, n. sp. (Pl. XXXVII.).

Sponge (Pl. XXXVII. fig. 1).—Small, growing from an attached incrusting base into variously shaped lobes, from the sides and ends of which slender, straight or crooked tubes with a terminal aperture or oscule are produced. The axial canal of the tubes is continued without any apparent change of dimensions a considerable distance into the lobes, within which it terminates by breaking up into branches.

The surface is covered by a smooth, thin, imperforate, wrinkled skin, the wrinkles of which are accurately reproduced by the surface of the skeleton below. Pores (?).

Spicules.—I. Megascleres. 1. *Ectosomal desma* (Pl. XXXVII. fig. 2), a broad undulating epirabd, giving off branches from the convex sides of the curves, and bifurcating at the ends; the cladi subdivide and give off lateral branches, and all the branches finally terminate in twig-like processes. The desma is depressed and ramified in a plane parallel to the surface, and the angles between the branches are mostly well rounded off; the twig-like endings of one desma are overlapped by those of its neighbours, and thus a close-meshed superficial network is produced without actual zygosis.

2. *Choanosomal desmas* (Pl. XXXVII. figs. 3–8), the characters of these are best conveyed by the illustrations. Forms like figs. 4–8 are richly developed in the tubular processes. Forms like fig. 3 occur beneath the ectosomal desmas, or immediately beneath the skin where these are absent. They present a straight epirabd, from the outer surface of which spined processes are given off, which end at the general surface of the sponge; from the inner face proceed a number of cladi (sometimes as many as seven), which

descend into the sponge, and articulate with the deeper lying desmas. The length of the crepidial axis averages 0·028 mm.

3. *Oxytylote* (Pl. XXXVII. figs. 10–20), rhabdome cylindrical or fusiform, smooth, terminating proximally in a sharply pointed or rounded off end, which may sometimes be thickened into an ellipsoidal enlargement; distally it expands into a rounded tylus, the distal region of which is covered with minute spines, sometimes directed distally, sometimes at right angles to the surface from which they spring. The axial rod is absent in many cases, and the canal which it occupied greatly enlarged. These spicules run lengthwise at the ends of the tubular processes, the tylote end is directed outwards, the oxeate end downwards and inwards (Pl. XXXVII. fig. 22); down the sides of the tubes and elsewhere they are arranged perpendicularly to the surface, the tylus frequently touching the skin, in which case they appear to be attached to it, the oxeate end as before being directed inwards. Rhabdome 0·42 to 0·57 by 0·005 mm., tylus 0·018 mm. in diameter.

Colour.—In the dried state the skin is a light yellowish-brown colour.

Habitat.—Station 192, off the Ki Islands, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud.

Remarks.—Three perfect specimens of this sponge were trawled; the tubular processes are about 1 mm. in diameter at the end, and may attain a length of 10 mm. The sponge is so exceedingly like *Siphonidium ramosum*, Schmidt, from Florida, Sombrero, and near Morro light, Gulf of Mexico, 125 to 240 fathoms, that at first I referred it to that species, nor should I have been able to discriminate between the two but for the possession of specimens of Schmidt's species, kindly presented to me by Professor Agassiz. Differences between the desmas of Lithistid species, unless of a very marked character, are difficult to determine, and except that Schmidt's specimens are much harder than mine, which would lead one to infer some kind of difference in the desma, I can discover no specific distinction in them. The rhabdi of the two are, however, sufficiently distinctive; in *Siphonidium ramosum* the adult spicule is 0·45 mm. long by 0·02 mm. thick at the distal end, and it is never tylote like the corresponding spicule of *Siphonidium capitatum*. Its form is most simply described as conical, attenuately pointed at the proximal, and rounded at the distal end; the distal end is frequently granulated. Notwithstanding its style-like form, it is truly biradiate, though uniaxial, as is shown by the occasional presence of an enlargement in the middle of the axial rod, which sometimes is accompanied by a corresponding inflation of the exterior of the spicule; the enlargement is seldom exactly in the middle, but about four-sevenths of the length of the spicule distant from the basal end. The young form of this spicule may be an oxytylote, like that of *Siphonidium capitatum*, but with subsequent growth the distinction between rhabdome and tylus disappears. The exquisite ectosomal desma with its arabesque tracery is present in both species.

Although the specimens of the Challenger collection are in a dried state, I cut and stained sections of them; these showed that the tubular processes are lined by reticulation of collenchyma, but nothing further (Pl. XXXVII. fig. 24). The specimens from Professor Agassiz were also cut, and the character of the slices is shown in fig. 23, Pl. XXXVII. They are sufficiently unpromising; nevertheless, in some of the larger patches of tissue I was able to make out the presence of flagellated chambers, as shown in fig. 25, Pl. XXXVII., and also of oval granular cells embedded in a stained collenchyma, similar to the prevailing tissue of *Azorica pfeifferæ*. The ectosomal desmas tear away in the process of cutting along with the outer layer of skin. Schmidt states that the pores of *Siphonidium ramosum* are generally distributed over the surface of the sponge; neither in Professor Agassiz's nor in the Challenger specimens, however, could I find any traces of pores, and I am still in doubt whether the tubular processes may not some perform an incurrent and others an excurrent function.

The development of the desma is illustrated by figs. 9–15, Pl. XXXVII., commencing with the crepidial strongyle (fig. 9), which in fig. 14 is seen enclosed within the epirabd. The zygosis of two desmas of the normal kind is shown in fig. 21, which is also intended to illustrate the mode of occurrence of small desmas which arise as an aftergrowth, filling up the meshes of the chief skeleton. The secondary desma is seen at the left hand lower corner of the illustration pointing towards the number 21.

Suborder II. ANOPLIA.

Lithistida in which special ectosomal spicules and microscleres are absent.

Family I. Azoricidæ.

Anoplia in which the desmas are monocrepid.

Genus 1. *Azorica*, Carter.

The pores and oscules are simple, and are borne on opposite surfaces of the plate-like sponge.

Azorica pfeifferæ, Carter (Pl. XXXVI.).

Azorica pfeifferæ, Carter, Ann. and Mag. Nat. Hist. 1, ser. 4, vol. xii. pp. 438, 442, 1873; vol. xviii. p. 466, 1876.
„ „ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 103, 121, 1878.

Sponge (Pl. XXXVI. fig. 1).—A thin plate, erect, much folded, with a rounded upper margin. Surface generally hispid, with long, slender, oxeate spicules; inner sur-

face more or less even, outer surface growing out here and there into rounded tubercles. Pores and oscules inconspicuous; the oscules are scattered over the inner surface, with circular slightly raised margins, from 0·16 to 0·2 mm. in diameter; the pores are restricted to the outer surface, situated singly in areas about 0·14 to 0·16 mm. in diameter, and surrounded by desmas; these areas are mostly arranged in longitudinal series.

Spicules.—I. Megascleres. 1. *Desma* (Pl. XXXVI. figs. 4–20), presenting the usual diversity of forms; approximately uniaxial varieties are about 0·32 to 0·35 mm. long, the protocladi of quadriradiate forms are about 0·16 mm. long; in each case the diameter of the epirabd or cladus, exclusive of spines, is about 0·02 to 0·025 mm. The epirabd or cladi are produced into short somewhat cylindrical processes, which usually bifurcate at the ends, each of the resulting smaller processes terminates in one, or usually more, simple or usually bifid spines with rounded ends. Beneath the epithelium of the ectosome these spines are free, and lie at about the same level, performing the function of a dermal spicule (Pl. XXXVI. fig. 29); deeper within the sponge they are interlocked and intergrown in the usual manner with the similar spines of adjacent desmas. On the free sides of the desmas that bound the larger canals the spines are stunted in their development, not growing out freely like those beneath the ectosomal epithelium.

2. *Oxea* (Pl. XXXVI. figs. 2, 3), slender, cylindrical, sharply pointed, straight, curved or slightly sinuous, 0·75 by 0·008 mm.; where they occur as hispidating spicules they project about 0·5 mm. beyond the surface.

Colour.—Ochreous-white.

Habitat.—Off Amboina; depth, 15 to 25 fathoms.

Station 33, off Bermuda, April 4, 1873; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud. Dredged.

Station 56, off Bermuda, May 29, 1873; lat. 32° 8′ 45″ N., long. 64° 59′ 35″ W.; depth, 1075 fathoms; bottom, coral mud; bottom temperature, 38°·2 F. Dredged.

Porto Praya, St. Iago, Cape Verde Islands, August 1873; depth from 100 to 128 fathoms.

Bahia.

Distribution.—Madeira, Portugal; off Cape St. Vincent, "Porcupine" Expedition, 374 fathoms (Carter).

Remarks.—The foregoing description and that which follows are taken from the specimen dredged at Amboina, the only one obtained in a living state, all the others being dead and denuded skeletons merely. The comparison of all the specimens, and their identification with *Azorica pfeifferæ*, will be discussed at the close of these remarks.

The specimen from Amboina is a fragment embracing probably the larger part of the

sponge, which when entire may very possibly have been vasiform. The base is broken, but doubtless it was attached. The fragment is 77 mm. in height measured along the side, 110 mm. in diameter, 380 mm. in circumference measured along the folds of the margin, and 220 mm. disregarding the folds. The thickness of the plate varies from 3·2 to 4·0 mm.

The large tubercles on the outer surface are sometimes perforated by an axial canal, which opens freely to the exterior, but more frequently they are imperforate; they appear to be produced in connection with attached foreign bodies, for when cut open such have invariably been found enclosed.

The oscules are shallow cup-shaped depressions, surrounded by desmas and hispidating oxeas; the bottom of the cup is centrally perforated by a longer or shorter canal, which is surrounded by concentric and radiating fusiform cells, probably myocytes. In its present condition the canal is closed. It leads into a vesicular enlargement, the commencement of the excurrent canal, which continues as a series of such vesicles, more or less elongated, in a somewhat curved course transversely through the sponge-wall. In a section of the wall where it is 3·2 mm. thick, the canals were traced for 1·6 mm. inwards, or exactly halfway across.

The skeleton of the sponge does not extend up to the cavity of the canal, but forms a tubular framework or tunnel, the hollow of which is chiefly occupied by the tissue in which the canal is excavated. The breadth of the skeletal tube varies from about 0·16 to 0·23 mm., of the lumen of the canal from 0·026 to 0·071 mm. The constrictions between the vesicular enlargements of the excurrent canal are frequently continued as vela; from the sides of the main vesicles lateral vesicles proceed, and from these canals which terminate in flagellated chambers. The incurrent canals are similar to the excurrent; the pores, none of which remain open in the present state of the sponge, lead into a poral dome which opens freely below into a subdermal cavity (Pl. XXXVI. fig. 28), which is subdivided into vesicles like the canals; from this the incurrent canals extend into the interior and communicate with the flagellated chambers by prosodal canals. The chamber-system is therefore diplodal (Pl. XXXVI. figs. 25, 26). The flagellated chambers are about 0·0237 mm. wide by 0·0197 mm. long.

Ectosome.—The ectosome is about 0·16 to 0·32 mm. thick. It differs from the choanosome simply by the absence of flagellated chambers.

The mesoderm (Pl. XXXVI. figs. 21–29) consists of a gelatinous matrix, which in some places takes a faint stain and in others not, enclosing various cellular constituents, of which the most conspicuous are oval or round cells, about 0·016 mm. in diameter, sharply outlined against the matrix, consisting of a granular protoplasm which takes a fairly deep stain, and a spherical vesicular nucleus 0·006 mm. in diameter, with a spherical nucleolus 0·002 mm. in diameter. In the granular protoplasm of the cells, and pparently developed at its expense, are certain little spherical bodies, each with a sharply

double-contoured wall, enclosing a few minute granules; both wall and granules are highly refringent, not stainable, and in general appearance strongly suggestive of a vegetable nature. The number of these structures within one cell is variable, there may be one, two, three, or four (and then frequently arranged as in a tetraspore), or many more; when numerous scarcely a trace of the original protoplasm of the cell remains (Pl. XXXVI. fig. 24).

Except in the ectosome and the walls of the larger canals, these comparatively large granular cells are so numerous that they seem to constitute the whole of the tissue, the gelatinous matrix being reduced to a minimum so small as to be scarcely discernible. But in the regions just excepted they are singly embedded, scattered about irregularly, in one place two or three lying in contact, in another separated by more than their own diameter. Other cellular constituents then come into view, such as the usual branching collencytes, but more noticeably small fusiform cells (Pl. XXXVI. figs. 22, 27), consisting of an oval or fusiform body, about 0·002 mm. in diameter, very deeply stained, and produced at one or both ends into a long, simple, or branching filament, frequently 0·085 mm. long. They mostly radiate at right angles to the nearest free surface of the tissue in which they occur, in the ectosome the outer surface of the sponge, in the canal-wall the epithelial surface of the canal. When the body of the cell is situated some distance from the free surface, then each end is produced into a filament; when it projects against the epithelium, then naturally only the end pointing away from the epithelium is so produced; sometimes a whole series of cells lying close together may be observed so situated, forming a subepithelial layer in the canal-wall. In the vela of the canals fusiform cells occur arranged concentrically about the central perforation. In some regions, as in the wall of the most superficial vesicles of the excurrent canals, the mesoderm passes into cavernous collenchyma.

Those desmas, which lie immediately beneath the outer epithelium, differ in several respects from those of the choanosome. They are chiefly extended in a plane parallel to the surface, and their outer faces are covered with erect tubercles bearing one or more simple or bifid spines. This ectosomal layer, by the closeness of its texture, presents quite a different appearance to that of the general skeleton, and is easily removed in continuous pieces by tangential section.

Variation.—The different specimens here assigned to the same species all differ in various points of detail from each other, and from the type specimen of *Azorica pfeifferæ*, Carter. The thickness of the wall of the sponge is in all slightly less than in the type, which measures about 0·5 mm. in thickness. The specimens from Stations 33 and 56 (both off Bermuda), and from Bahia, agree most closely in this respect, not varying much on either side of 3 mm., that from Porto Praya is about 5 mm. thick, and most resembles in other respects the typical specimen; that from Amboina does not exceed ·4 mm. in thickness. The size and proximity of the oscules is another very variable

character: they are largest and most remote in the type and in the specimen from Porto Praya, in both these they measure about 0·45 to 0·5 mm. in diameter; in the other specimen they are smaller, varying from 0·16 to 0·32 in diameter, and in their distances from one another they vary still more widely. In the specimen from Station 33 from four to six can be seen at one time in the field of the microscope, in that from Station 56 as many as nineteen or twenty, and in that from Amboina about twelve. The size of the main excurrent canals and pores varies in correspondence with that of the oscules.

The desmas are similarly variable, those in the specimen from Amboina are thicker, and more richly tubercled than in any of the others, including the type. These differences are so marked, that it has been a question of much perplexity as to how far they should be recognised in our nomenclature; since, however, in each case we have only individual specimens to deal with, and since it would be impossible to discriminate them without giving a specific name to each individual, I have thought it most convenient to group them together as a single species, adding here a summary of their differences.

Azorica pfeifferæ, Carter. Type, and specimen from Porto Praya. Sponge-wall comparatively thick, oscules large, marginate, desmas comparatively slender and smooth.

Azorica pfeifferæ tenui-laminaris. Specimen from Station 56 and Bahia. Sponge-wall comparatively thin, oscules small, closely approximated, desmas comparatively slender and smooth.

Azorica pfeifferæ tenui-laminaris, osculis disjunctis. Specimen from Station 33. Sponge-wall comparatively thin, oscules small, marginate, comparatively remote, desmas comparatively slender and smooth.

Azorica pfeifferæ intermedia. Specimen from Amboina. Sponge-wall intermediate in thickness between *Azorica pfeifferæ*, type, and *Azorica tenui-laminaris;* oscules small, closely approximated, desmas comparatively thick and highly tuberculated.

The slight differences between the specimens do not appear to be correlated with differences of habitat, unless in the case of the specimen from Amboina; the stouter form of desma in this being possibly connected with its occurrence in comparatively shallow water (15 to 25 fathoms).

Azorica marginata, n. sp. (Pl. XXXV. figs. 14–22).

Sponge.—Small, ear-shaped, attached, inclined so that the oscular surface is downwards, the poriferous face upwards. Margins rounded, oscules simple, small, with circular, raised margins, 0·475 mm. in diameter. Pores simple, small.

Spicules.—I. Megascleres. 1. *Desma* (Pl. XXXV. figs. 14–21), somewhat short and thick, densely tuberculated, tubercles bearing bifid spines. Total length of a curved form 0·238 mm., of an elongated straight form 0·4 mm., a single branch of a quadriradiate

form 0·16 mm., diameter 0·04 mm., crepidial axis 0·02 mm. in length. The zygose terminations of two cladi are shown in fig. 18.

2. *Oxea* (Pl. XXXV. fig. 22) slender, very attenuately pointed, 0·32 by 0·004 mm.

Colour.—In the dried state yellowish-white. Size, 13 mm. in height by 15 mm. in breadth, thickness of the wall 4 mm.

Habitat.—Station 192, off the Ki Islands, south of Papua, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud.

Remarks.—This might easily be mistaken for a young specimen of *Azorica pfeifferæ;* the characters of the desma suffice to distinguish it.

Azorica crassiuscula, n. sp. (Pl. XXXV. figs. 1–11).

Sponge (Pl. XXXV. figs. 1, 2).—A somewhat thick plate (7 mm. thick), curved, so as to present an outer convex surface (Pl. XXXV. fig. 1), which grows out into irregular, sinuous ridges, and an inner concave surface (Pl. XXXV. fig. 2), which is more even. Upper margin broad, sinuous, rounded. Base attached. Oscules circular, with a very slightly elevated margin (0·32 to 0·4 mm. in diameter), scattered over the inner face. Openings of the incurrent canals (as represented in the skeleton) scattered over the outer face, circular, small (0·24 to 0·32 mm. in diameter). The incurrent and excurrent canals cross the wall transversely.

Spicules.—I. Megascleres. 1. *Desmas* (Pl. XXXV. fig. 11), similar to those of *Azorica pfeifferæ;* the average length of a cladus is 0·16 mm. The youngest desma (Pl. XXXV. fig. 5) observed is an almost cylindrical strongyle, only very slightly enlarged at the ends, much corroded in appearance, and measuring 0·055 mm. in length by 0·0075 mm. in diameter. The length of the crepidial axis (Pl. XXXV. fig. 11) varies in different desmas from 0·032 to 0·045 mm. There is a greater tendency to a uniaxial growth amongst these desmas than in those of *Azorica pfeifferæ.*

2. *Oxea* (Pl. XXXV. fig. 3), long, slender, fusiform, or almost cylindrical, with sharply pointed ends or with the points rounded off. The longest observed measures 1·193 by 0·012 mm.; but so few entire spicules were seen that this length may be exceeded.

Colour.—In the dried state, grey.

Habitat.—Locality not known. The specimen occurs attached to the base of *Discodermia ornata.*

Remarks.—The successive stages in the development of the desma are shown in figs. 4–10 (Pl. XXXV.). They present no essential points of difference from those of other monocrepid desmas.

Genus 2. *Tretolophus*, n. gen.

Azoricidæ in which the oscules are arranged in a linear series along the summit of a ridge-like elevation. Main excurrent canals more or less vertical.

This genus is provisional, founded on a single dead specimen.

Tretolophus paniceus, n. sp.

Sponge.—Small, attached by an irregular base, ridge-like. Oscules small, 0·7 to 0·8 mm. in diameter, arranged in a series on the summit of the ridge, the simple openings of vertically descending excurrent canals.

Spicules.—I. Megascleres. 1. *Desmas*, like those of *Azorica;* epirabd and cladi short and thick, bearing numerous stout tubercles which terminate in long, simple or bifid spines, diameter of the epirabd about 0·03 to 0·04 mm., sometimes more; crepidial axis 0·02 mm. in length.

2. *Strongyloxea* (?), 0·2 by 0·002 mm.

II. Microscleres (?). 3. *Microxea*, fusiform, sharply pointed, 0·1 by 0·004 mm.

Colour.—The specimen is a dead skeleton. Size, 14 mm. in length by 7 mm. in width where widest, to 3 mm. where narrowest, and 6 mm. in height.

Habitat.—Station 192, off the Ki Islands, south of Papua, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud.

Remarks.—The strongyloxea and microxea, marked as only doubtfully present, occur amongst the loose material detached by boiling in nitric acid; so many other spicules of different kinds, evidently foreign to the sponge, are associated with them, that I doubt very much whether they should be included in the description.

SUPPLEMENTARY ACCOUNT OF SPECIES NOT CONTAINED IN THE CHALLENGER COLLECTION.

Order LITHISTIDA, O. Schmidt.

Suborder I. HOPLOPHORA.

Demus I. TRIÆNOSA.

Family I. TETRACLADIDÆ (Zittel).

Genus 1. *Theonella* (Gray).

Theonella prattii (Bowerbank).

Dactylocalyx prattii, Bowerbank, Proc. Zool. Soc. Lond., p. 89, pl. v. figs. 6–11, 1869.
„ „ Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 438, 1873.
Theonella pratti, Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 103, 151, pl. i. fig. 9*b*, 1878.
Theonella swinhoei (*pars*), Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 147, 1880.

Sponge.—Irregularly cup-shaped, pedicelled; surface even, slightly undulating. Oscules simple, small, dispersed, numerous. Pores in sieves.

Spicules.—I. Megascleres. 1. *Desma*, epactines smooth, cylindrical, about 0·16 by 0·047 mm.; cladi short, rapidly breaking up into numerous syzygial tubercles; zygosis terminal; crepidial axis 0·1 mm. long. 2. *Discotriæne*, rhabdome conical, strongylate, 0·125 to 0·16 mm. in length; protocladi 0·09 to 0·13 by 0·032 mm., deuterocladi 0·14 to 0·25 mm., cladal axis 0·032 mm. long. 3. *Oxea*, 0·006 mm. in diameter, length not ascertained.

II. Microsclere. 4. *Microstrongyle*, straight, bacillary, surface roughened, 0·01 by 0·002 mm.

Colour.—Light brown, in the dried state. Size, 100 mm. in height; major and minor axes of the brim of the cup 113 mm. and 88 mm.

Habitat.—East Indies (?). Possibly from the Indian Ocean, off the coast of Hindustan.

Remarks.—This sponge is distinguished from *Theonella swinhoei* by the characters of the excurrent canal-system, and also by the comparative minuteness of the microstrongyle, which also is straight in *Theonella pratti*, and usually curved in *Theonella swinhoei*, a distinction pointed out by Carter.

Theonella ferruginea, Haeckel.

Theonella ferruginea, Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 103, 151, pl. i. fig. 9*a*, 1878.

This species has not been described; it rests on an illustration given by Zittel (*loc. cit.*).

Genus 2. *Discodermia.*

Discodermia (?) aspera, Carter.

Discodermia aspera, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 147, pl. viii. fig. 49, 1880.

Sponge.—Small, incrusting; surface even; oscules and pores (?).

Spicules.—I. Megascleres. 1. *Desma*, of the usual form, epactines 0·039 to 0·048 mm. in diameter, axial rod 0·05 to 0·06 mm. long, up to its point of bifurcation at the cladal origin covered with sharp spine-like tubercles. 2. *Discotriæne*, cladome margin denticulated, irregularly lobate, distal surface covered with sharp spines, 0·12 to 0·2 mm. in diameter; rhabdome, conical strongylate, 0·024 to 0·036 mm. long.

II. Microscleres. 3. *Microxea*, minutely spined, 0·058 mm. long. 4. *Microstrongyle*, fusiform, 0·016 mm. long.

Colour.—Grey. Size, about 25 mm. in diameter.

Habitat.—Gulf of Manaar; depth, under 65 fathoms.

Remarks.—A prepared slide of this sponge was presented me by Dr. Carter; I must confess I cannot trace the passage of the discotriæne into the desma.

Discodermia calyx, Döderlein.

Corallistes polydiscus (?), Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 464, 1876.
Racodiscula, n. sp., Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 151, 1878.
Discodermia calyx, Döderlein, Zeitschr. f. wiss. Zool., Bd. xl. p. 62, pl. v., pl. vii. figs. 5, 6, 1884.
Racodiscula asteroides, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xv. p. 400, pl. xiv. figs. 11*a*–11*g*, 1885.

Sponge.—Vasiform or cylindrical, with a large central cup-like cavity, divided below into root-like lobes, or attached by an expanded base; wall thick. Surface even. Oscules confined to the interior of the cup, more numerous at the bottom. Pores (?).

Spicules.—I. Megascleres. 1. *Desma*, actines smooth, syzygial tubercles "diffuse, not circumscribed nor globular." 2. *Discotriæne*, rhabdome short, conical, pointed; cladome thin, circular or trilobed, 0·35 mm. in diameter. 3. *Phyllotriæne*, branched elk-horn-like, 0·64 mm. in diameter. 4. *Oxea*, fusiform, curved, 1·16 by 0·01 mm.

II. Microscleres. 5. *Microxea*, fusiform, curved, minutely spined, 0·0465 by 0·0028 mm. 6. *Microstrongyle*, elliptical, compressed, minutely spined, 0·0127 to 0·0157 mm. long by 0·0042 mm. wide, and much less in thickness.

Colour.—Yellowish-grey. Size, the typical specimen is 88 mm. in height by 69 mm. in maximum diameter; the cup-like cavity 44 mm. wide by 25 mm. broad and 63 mm. deep; the wall is 9 mm. wide at the brim, but becomes thicker downwards. A second

vasiform specimen measures 113 mm. in diameter across the brim, and 113 mm. in height; the central cavity is 75 mm. deep.

Habitat.—Japan, Misaki, at the entrance of the Bay of Tokio (Carter). Island of Enoshima, Bay of Sagami, Japan; depth, 30 to 60 fathoms (Döderlein).

Discodermia dissoluta, O. Schmidt.

Discodermia dissoluta, O. Schmidt, Spong. Meerb. Mexico, p. 87, pl. v. fig. 2, 1880.

Sponge.—Branching, branches cylindrical, but flattened on the side bearing the oscules. Oscules several, confined to one side of the sponge, situated near the ends or in the middle of the branches, or in the angle between them; small, surrounded by a smooth membrane, which is slightly depressed below the general level of the sponge, and forms the roof to a widely extending, shallow cloaca, into which numerous small excurrent canals open. Pores simple, small, 0·019 to 0·1 mm. in diameter, generally distributed. Consistence soft, like that of a Renierid sponge.

Spicules.—I. Megascleres. 1. *Desmas*, precisely similar to those of *Theonella swinhoei* when immature, at a stage immediately preceding the appearance of syzygial tubercles. The epactines are united by plate-like extensions between the angles they make about their origin. They terminate in flattened plate-like ends, or in two or more flattened cladi, without giving rise to tubercles; zygosis is of the loosest description, produced by the abutment against each other of the ends of the desmas.

Here and there desmas are met with in which the epactines are cylindrical, and provided with syzygial tubercles. The crepidial axis is variable in length, frequently 0·06 mm., the length of the epactine varies from about 0·08 to 0·16 mm. 2. *Discotriæne*, cladome disciform or cyathiform, margin usually entire, seldom presenting a rhabdal sinus; 0·26 mm. in diameter, when cyathiform the depth of the cup 0·065 mm., rhabdome conical, strongylate, 0·118 by 0·0118 mm. The axial fibres of the cladome 0·02 mm. long. 3. *Oxea*, 0·8 by 0·1 mm., frequently tornotate, or strongylate.

II. Microscleres. 4. *Microxea*, fusiform, surface roughened, very variable in size, up to 0·05 by 0·004 mm. 5. *Microstrongyle*, bacillar, surface roughened, 0·0118 to 0·016 mm. long.

Colour.—Dark greyish-white. Size, the length of the largest specimen, which is not complete, is 78 mm., diameter of the stem 15 mm., the branches are 10 mm. thick from the oscular to the opposite surface, and 18 mm. wide.

Habitat.—Barbados; depth, 56 fathoms.

Remarks.—No one by merely looking at this sponge and handling it would suspect its Lithistid nature. So far from being of stony hardness, it is almost as soft as a bath sponge. This is due to the general absence of zygosis, the desmas having apparently

suffered an arrest of development. The oscules are surrounded with a slightly thickened margin, and sometimes one or more smaller accessory oscules occur in the same cloacal roof as the main centrally situated one. The cloacal roof is about 9 or 10 mm., and the oscule 1 mm. in diameter; but in one instance out of the four present in one specimen it has become enlarged to 4 mm. in diameter at the expense of the cloacal roof. In this case the openings of the excurrent canals in the floor of the cloaca are fully revealed. This conversion of a cloaca with a small oscule to a wide superficial depression with an oscule as wide or almost as wide as itself is a phenomenon of very frequent occurrence.

Discodermia japonica, Döderlein.

Discodermia japonica, Döderlein, Zeitschr. f. wiss. Zool., Bd. xl. p. 62, pls. v.–vii., 1884.

Sponge.—Clavate or conical, in older examples once or oftener dichotomising; oscules situated in the middle of the summit, or at the ends of the branches. Pores (?).

Spicules.—I. Megascleres. 1. *Desma*, epactines of equal length, smooth, or with transverse crescentic ridges and tubercles, cladose, cladi ending in tubercles and other syzygial processes. Total length from 0·3 to 0·8 mm., of epactines 0·1 to 0·5 mm., thickness near the centre 0·03 to 0·13 mm. 2. *Discotriæne*, similar to that of *Discodermia discifurca*. 3. *Oxea*.

II. Microscleres. 4. *Microxea*, fusiform, curved, smooth. 5. *Microstrongyle*, ellipsoidal, minute.

Habitat.—Island of Enoshima, Bay of Sagami; depth, 30 to 60 fathoms.

Discodermia (?) *lævidiscus*, Carter.

Discodermia lævidiscus, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 503, pl. viii. fig. 51, 1880.

Sponge.—Small; surface even.

Spicules.—I. Megascleres. 1. *Desma* (not sufficiently characterised), syzygial processes expanded, irregular. 2. *Discotriæne*, depressed in the centre or cyathiform.

II. Microsclere. 3. *Microxea*, minutely spined, 0·034 mm. long.

Colour.—Yellow internally. Size, about 6 mm. in diameter.

Habitat.—Gulf of Manaar, Indian Ocean; depth, under 65 fathoms.

Discodermia (?) *papillata*, Carter.

Discodermia papillata, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 146, pl. viii. fig. 48, 1880.

Sponge.—Small, incrusting and burrowing; surface even. Oscules and pores (?).

Spicules.—I. Megascleres. 1. *Desma*, of the usual characters, covered with wart-like

tubercles. 2. *Discotriænes*, those of the outermost layer circular, those beneath larger and with lobate divided margins; outer surface minutely papillated, *i.e.*, bearing short, conical spines.

II. Microscleres. 3. *Microstrongyle*, ellipsoidal, minutely spined, 0·0127 mm. in length.

Habitat.—Gulf of Manaar; depth, under 65 fathoms.

Discodermia polydiscus, Bocage.

Discodermia polydiscus, Bocage, Journ. d. Sc. Math. phys. et nat. Lisbonne, p. 160, pl. xi. fig. 1, 1869.
Dactylocalyx polydiscus, Bowerbank, Proc. Zool. Soc. Lond., p. 96, pl. vi. figs. 9–14, 1869.
Not Corallistes polydiscus, O. Schmidt, Spong. Atlant. Gebiet., p. 24, pl. iii. figs. 8, 9, 1870.
Discodermia polydiscus, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 462, 1876.
„ „ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 151, pl. i. fig. 7, 1878.
Not „ „ O. Schmidt, Spong. Meerb. Mexico, p. 22, 1879.

Sponge.—Variable in form, irregularly cup-shaped, with a short pedicle and thick walls; surface even. Oscules small, marginate, situated on the summit of slight elevations, or not dispersed.

Spicules.—I. Megascleres. 1. *Desma*, epactines smooth, cylindrical, simple, or cladose, syzygial tubercles rounded, zygosis terminal. 2. *Discotriæne*, rhabdome conical, oxeate, cladome disciform, margin entire or lobate, about 0·3 mm. in diameter. 3. *Oxea.*

II. Microscleres. 4. *Microxea*, fusiform, surface roughened, 0·055 mm. in length. 5. *Microstrongyle*, 0·011 by 0·003 mm.

Colour.—When dry, light fawn-brown.

Habitat.—Coast of Portugal (Bocage), near Cape St. Vincent (?) (Carter), and Island of St. Vincent, West Indies (Bowerbank).

Discodermia (?) *sinuosa*, Carter.

Discodermia sinuosa, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vii. p. 372, pl. xviii. fig. 1, 1881.

Sponge.—Small, surface even.

Spicules.—I. Megascleres. 1. *Desma*, of the usual tetracladine character. 2. *Discotriænes*, those most external, circular with a simple margin, those lying deeper, foliate with shallow denticulations, those deeper still, growing out into sinuous, branching, foliate lobes.

II. Microsclere. 3. *Microstrongyle*, fusiform, centrotylote, minutely spined.

Size, 13 mm. in diameter.

Habitat.—Off Tuticorin, Gulf of Manaar; Basse Rocks, south-east coast of Ceylon.

Discodermia vermicularis, Döderlein.

Discodermia vermicularis, Döderlein, Zeitschr. f. wiss. Zool., Bd. xl. p. 62, pls. v.–vii., 1884.

Sponge.—Vermiform, consisting of long, slender, curved, dichotomising and anastomising twigs; when the twigs are very numerous becoming shrub-like. Oscules on one side of the twigs somewhat elevated.

Spicules.—Similar to those of *Discodermia calyx* and *Discodermia japonica*.

Habitat.—Island of Enoshima, Bay of Sagami; depth, 100 fathoms and over.

Incertæ sedis.

Discodermia amphiaster, O. Schmidt.

Discodermia amphisaster, O. Schmidt, Spong. Meerb. Mexico, p. 23, pl. iii. fig. 4, 1879.

This is probably a *Macandrewia*, and probably also identical with an already described species of the genus. No specimen of it exists in the collection of Mexican sponges returned by Schmidt to Agassiz. It is reported as having been found near Havanna.

Genus 3. *Racodiscula*, Zittel.

Tetracladidæ with discotriænes; the microscleres are microrabds and spirasters; the pores and oscules are simple.

Racodiscula nucerium (O. Schmidt).

Discodermia nucerium, O. Schmidt, Spong. Meerb. Mexico, p. 25, pl. i. fig. 4, pl. iii. figs. 1*a–z*, fig. 6, 1879.

Sponge.—Small, rounded, teat-like, attached by a flattened base. Surface even, or produced in places into small elongate papillary processes. Oscules and pores similar, small, numerous, seated on slight elevations, from which small canals radiate into the sponge in all directions, the most superficial appearing as systems of stellate grooves in the denuded skeleton, and in the living sponge covered by the discotriænes of the ectosome.

Spicules.—I. Megascleres. 1. *Desma*, of the usual tetracladine form. 2. *Discotriæne*, cladome more or less circular or lobate, lobes broad or narrow, according to position, 0·32 mm. in diameter; rhabdome conical, rounded at the end, 0·032 to 0·05 mm. in length. The axial rod of the rhabdome gives off the usual three processes, representing the axis of three cladi where it ends in the cladome, but these are not always present; when they are, they vary in length from 0·004 to 0·02 mm. 3. *Oxea* (?).

II. Microscleres. 4. *Microstrongyle*, fusiform or bacillar, centrotylote or not, surface much roughened by minute spines, 0·03 mm. in length. 5. *Spiraster*, 0·02 mm. in length, sometimes passing into a quadriradiate aster.

Colour.—Brownish-grey. Size, base about 20 mm. in diameter, 11 mm. in height.

Habitat.—Havanna; depth, 120 to 240 fathoms.

Remarks.—Several tangential slices from the general surface were made to determine the character of the pores, but only one or two simple oval openings were detected; these measured from 0·02 to 0·06 mm. in diameter, and were situated over the superficial water canals, which are bounded on three sides by the desmas, and on the fourth and outer side by the discotriænes. It would appear from the rarity of pores over the general surface that some special poriferous area must exist somewhere on the sponge; to determine this and the character of the oscules, tangential slices were taken from two of the slight eminences which form the centre of the stellate systems of superficial canals. Both of these presented numerous small round or oval apertures, from 0·02 to 0·08 mm. in diameter, and in their neighbourhood the discotriænes presented much deeper incisions of the margin than in other regions of the sponge, *i.e.*, they are distinguished by poral sinuses, while rhabdal sinuses alone, or almost alone, occur in the cladomes of the triænes of the general surface. Similar as the openings on the different eminences are to one another, a difference in function is not precluded, and it is quite possible that the pores of one eminence may be truly incurrent apertures, and of another excurrent. Schmidt seems to speak of the presence of a distinct oscule with a small cloaca; nothing of the kind could be discerned in the specimens sent me by Professor Agassiz, and labelled *Discodermia nucerium* in Schmidt's own handwriting.

A portion of the surface is overgrown by an incrusting *Desmacidine* sponge.

Racodiscula polydiscus (O. Schmidt).

Corallistes polydiscus, O. Schmidt, Spong. Atlant. Gebiet., p. 24, pl. iii. figs. 8, 9, 1870.
Racodiscula asteroides, Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 103, 151, 1878.
? Pomelia schmidtii, Zittel, *tom. cit.*, p. 126, pl. i. fig. 4, 1878.
Discodermia polydiscus, O. Schmidt, Spong. Meerb. Mexico, p. 22, 1879.

Sponge.—Variable in form, clavate, with a short pedicle and expanded base for attachment, or cushion-shaped or cylindrical, bearing several small circular oscules at the summit, the openings of vertically descending excurrent canals. Pores (?).

Spicules.—I. Megascleres. 1. *Desma*, epactines cylindrical, smooth, syzygial tubercles rounded. 2. *Discotriæne*, cladome, margin entire or lobate, 0·23 mm. in diameter. 3. *Oxea.*

II. Microscleres. 4. *Microxea*, fusiform, centrotylote, slender, 0·035 by 0·0025 mm. 5. *Microstrongyle*, bacillar, surface much roughened by minute erect spines, 0·016 by

0·003 mm. 6. *Spiraster*, very variable, passing into metasters and plesiasters, the latter into microxea; total length of spiraster, 0·0237 mm., of a single actine of a plesiaster with four actines, 0·016 mm. The microxea (No. 4) is evidently derived from the spiraster.

Habitat.—Florida; depth, 152 to 183 fathoms. Cuba; depth, 270 fathoms. Havanna; depth, 124 fathoms.

Remarks.—The description of the spicules is taken from a small conical specimen, attached by a broad base, and labelled *Discodermia polydiscus* in Schmidt's handwriting; it was sent me by Professor Agassiz, who obtained it at a depth of 124 fathoms off Havanna.

Racodiscula (?) *sceptrellifera* (Carter).

Discodermia sceptrellifera, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vii. p. 373, pl. xviii. fig. 2, 1881.

Sponge.—Small, about 6 mm. in diameter; surface even.

Spicules.—I. Megascleres. 1. *Desma*, of the usual character. 2. *Discotriæne*, passing from a circular form to one with three irregularly branching broad lobes.

II. Microsclere. 3. *Amphiaster*, short, thick, sceptre-like.

Colour.—Yellow.

Habitat.—Gulf of Manaar; depth, under 65 fathoms.

Racodiscula spinispirulifera (Carter).

Discodermia spinispirulifera, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 502, pl. viii. fig. 50, 1880.

Sponge.—Small, about 6 mm. in diameter.

Spicules.—I. Megascleres. 1. *Desma*, syzygial tubercles subglobular. 2. *Discotriæne*, margin of the cladome circular or lacerated or irregularly branched.

II. Microscleres. 3. *Microxea*, fusiform, curved, minutely spined, 0·083 mm. long. 4. *Spiraster*, 0·0125 mm. in length.

Habitat.—Gulf of Manaar; depth, under 65 fathoms.

Genus 4. *Kaliapsis*, Bowerbank.

Tetracladidæ which occur as thin incrusting plates, having the desmas of the base peculiarly modified; the discotriænes are tuberculated on the outer surface. The microsclere is a microstrongyle.

Kaliapsis cidaris, Bowerbank.

Kaliapsis cidaris, Bowerbank, Phil. Trans., pl. xxiv. figs. 32–38, 1858, and p. 759, pl. xxviii. fig. 12, 1862; Mon. Brit. Spong., vol. i. p. 80, pl. iv. figs. 102, 103, pl. v. figs. 104–108, 1864; Proc. Zool. Soc. Lond., pp. 76, 337, pl. xxv. figs. 2–5, 1869.
" " Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 441, 1873.
" " Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 103, 152, pl. i. figs. 12, 12*a*, 1878.

Sponge.—Incrusting, very thin. Oscules and pores (?).

Spicules.—I. Megascleres. 1. *Desma*, actines smooth, cylindrical, syzygial ends finely branched, terminating in numerous somewhat elongated tubercles. The desmas of the lowermost layer of the skeleton are orientated so that one epactine projects at right angles to the underlying surface, the other three are curved backwards or upwards. The single basal epactine is not branched, and has the form of a conical spine, surrounded over its proximal half by a zone of longitudinal rounded ridges or elongated tubercles. Hence the specific designation "cidaris."

2. *Discotriæne*, rhabdome short, cladome disciform, circular, or elaborately branched, bearing boss-like tubercles on the outer surface. *Rhabdus* (?).

II. Microsclere. 3. *Microstrongyle*, fusiform, 0·028 by 0·0042 mm.

Colour.—(?). Size, 6 mm. in diameter, by 0·62 mm. in thickness.

Habitat.—South Seas; growing over *Oculina rosacea*.

Remarks.—Although the specimen from which Bowerbank's description is taken is a dried one, it retains portions of the tissue, and in this microstrongyles were found in great numbers. As Bowerbank examined these under a power magnifying 666 diameters, he would have seen spirasters had they been present; as he does not mention them, we may conclude their absence.

Neosiphonia schmidtii, n. sp.

Jereopsis sp., O. Schmidt, Spong. Meerb. Mexico, p. 20, pl. ii. fig. 10, 1879.

Sponge.—Pyriform, supported on a short pedicle, summit flattened, oscules confined to the summit, the openings of longitudinal excurrent canals.

Spicules.—I. Megascleres. 1. *Desma*, epactines cylindrical, smooth, about 0·127 by 0·039 mm. to 0·16 by 0·05 mm.; seldom bifurcating more than once, cladi short, breaking up into numerous syzygial tubercles; zygosis generally terminal. 2. *Triæne* (?), said by Schmidt to be absent.

II. Microscleres (?).

Habitat.—Gulf of Mexico; depth, 80 to 92 fathoms (O. Schmidt). Near Havanna; depth, 80 and 175 fathoms. Lat. 22° 9′ 30″ N., long. 52° 21′ 20″ W.; depth, 292 fathoms. Off Morro Light; depth, 805 fathoms.

Remarks.—The fragments which I received from Professor Agassiz, and which are now, by his permission, placed in the British Museum, were parts of the dead skeleton of the sponge, so that I am not able to supplement Schmidt's description with an account of the smaller spicules.

The resemblance of the desmas to those of the fossil *Siphonia* (in which we suppose *Jerea* to be included) is much closer than in the case of *Neosiphonia superstes*. A similar resemblance exists in the outer form and the general arrangement of the canal-system, so that with much plausibility we may regard *Neosiphonia* as a lineal descendant from the Mesozoic *Siphonia*.

The additional localities for the sponge were kindly communicated to me by Mr Walter Fewkes, who states that all the specimens, of which there are four, are "dry." This confirms my impression that they are also deciduous.

Genus 5. *Rimella*, O. Schmidt.

Generic characters partly included in the description of the single species, partly unknown.

Rimella clava, O. Schmidt.

Rimella clava, O. Schmidt, Spong. Meerb. Mexico, p. 21, pl. i. fig. 2, pl. ii. figs. 5, 7, 11, 1879.

Sponge.—Small, more or less clavate, attached by a flat expanded base, growing out at regular intervals on alternate sides into protuberances, which may enlarge into short branches; the soft parts being removed, a number of somewhat deep longitudinal furrows are seen descending from the summit of the sponge to the lateral protuberances, and from them to the base.

Spicules.—I. Megascleres. 1. *Desma*, various in form, sometimes regularly tetracladine, sometimes wholly irregular, bearing large tubercles, which are not confined to the ends of the cladi, but extend over their sides, frequently up to the actinal centre, often confined to one side of a cladus. The tubercles when fully grown present a short cylindrical pedicle, constricted in the middle, so that the sides are concave in outline; and an expanded cushion-like tylus, which is sometimes faintly lobed; height of the tubercle 0·039 mm., diameter of the pedicle 0·032 mm., of the tylus 0·045. The axial fibre of the crepis seldom exceeds 0·09 to 0·115 mm. in length, while the total length of an epactine and cladus is usually 0·23 to 0·32 mm.; in one or two instances only was the axial fibre observed to extend to the extremity of an epactine, which in this instance measured 0·19 mm. in length. In another instance the fibre was seen to dichotomise at the end of the epactine where the protocladi originate; the axial fibre of the epactine measured 0·084 mm., of the protocladus 0·013 mm. in length. Zygosis occurs not only at the

ends of the cladi but along their whole length, syzygial laminæ growing over the cladus as far as tubercles are present. 2. *Discotriæne* (?). 3. *Oxea*, fusiform, occasionally bearing one or more lateral rounded tubercles, 0·6 by 0·013 mm.

II. Microscleres. 4. *Microxea*, fusiform, slender, centrotylote; 0·045 mm. in length.

Colour.—(?). Size, about 20 mm. in height by 5 mm. in diameter.

Habitat.—Havanna; depth, 292 fathoms.

Remarks.—The protuberances on the sides of the sponge are few in number, from one to three, and appear to be spirally arranged; they give the outline of the sponge an undulating zigzag appearance; thus in a specimen with two protuberances the sponge slopes in a straight line to one side as far as the first protuberance, then it bends to the other side and proceeds obliquely in a straight line to the next protuberance; from this again it bends to the opposite side, and then continues obliquely in a straight line to the summit. All the specimens I have seen are merely skeletons devoid of ectosomal spicules, hence the appearance of furrows on the surface, which as Schmidt remarks were naturally covered over by a dermal membrane in the living state. No canals of equal diameter to that of the furrows are seen at the summit of the sponge or of the lateral protuberances.

Two specimens were boiled in nitric acid in the expectation of detaching any loose spicules which might be present. In this way several lobate discotriænes like those of *Discodermia polydiscus* were obtained, but these may be foreign inclosures; the microxeas, however, which were thus obtained are so abundant and fresh that I have unhesitatingly included them in my description of the spicules proper to the sponge.

Genus 6. *Collinella*, O. Schmidt.

Generic character partly included in the description of the single species, partly unknown.

Collinella inscripta, O. Schmidt.

Collinella inscripta, O. Schmidt, Spong. Meerb. Mexico, p. 21, pl. i. fig. 3; pl. ii. fig. 12, 1879.

Sponge.—Pyriform or almost spherical, with a short, somewhat cylindrical pedicle, attached by an expanded base. A single oscule at the summit leading into a tubular cloaca, which extends axially downwards to the base, or additional smaller oscules are present, the additional cloacas running parallel to the main one. Excurrent canals, curved, running more or less longitudinally and parallel to the general surface, the most superficial exposed as deep branching grooves in deciduous specimens. The general surface raised into low monticules, from the summits of which the incurrent canals proceed, radiating in all directions, from right angles to the surface to parallelism with

it; the most superficial or subdermal canals revealed as deep grooves in deciduous specimens.

Habitat.—Morro Light; depth, 292 fathoms.

Remarks.—The specimen of this sponge, which I received from Professor Agassiz, is smaller than any of those figured by Schmidt, about 15 mm. in diameter, by 18 mm. in height. It is entirely devoid of soft parts and loose spicules; the desmas are comparatively small, an epactine from the actinal centre to zygosis measured 0·039 by 0·019 mm.; the cladi are richly tuberculated, and the syzygial lamina extend over them for considerable distances, sometimes nearly to the actinal centre.

Genus 7. *Sulcastrella*, O. Schmidt.

Generic character partly included in the description of the single species, partly not known.

Sulcastrella clausa, O. Schmidt.

Sulcastrella clausa, O. Schmidt, Spong. Meerb. Mexico, p. 27, pl. i. fig. 5; pl. ii. fig. 6; pl. iii. fig. 7, 1879.

Sponge.—Incrusting, oscules absent, pores numerous; surface raised into low convex areas, each of which is occupied by a stellate system of anastomosing subdermal canals radiating from the centre.

Spicules.—I. Megascleres. 1. *Desma*, triradiate, with a triradiate axial fibre, distinguished by peculiar finger-like or claw-like processes, syzygial processes not unfrequently surrounded by undulating collar-like processes.

2. *Strongyle*, slender.

II. Microscleres (?).

Habitat.—Sand Key, Gulf of Mexico; depth, 129 fathoms.

Remarks.—I have not seen this sponge, which Schmidt places with the Rhizomorina, and compares to the fossil *Astrobolia*, Zittel; but it appears to me, at least superficially, more closely to resemble *Spongodiscus*, Zittel, which is a Tetracladine Lithistid, as I think is the sponge under consideration.

Family II. Corallistidæ.

Genus 1. *Corallistes*, O. Schmidt.

Corallistes (?) *aculeata*, Carter.

Corallistes aculeata, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 143, pl. vii. fig. 45, 1880.

Sponge.—Small, about 6 mm. in diameter. Incrusting (?).

Spicules.—I. Megasclere. *Desmas*, quadriradiate, those of the outermost layer definitely orientated, three basal rays proceeding inwards, and the fourth or apical outwards, at right angles to the surface. Basal rays, cladose; apical, simple, conical, elongated, subsinuous, 0·08 mm. by 0·21 mm. in diameter at the base (? 0·21 mm. long by 0·08 mm. in diameter), bearing rounded conical tubercles, arranged in more or less circular rows around the lower two-thirds of the ray; syzygial tubercles angular.

II. Megasclere (?).

Habitat.—Gulf of Manaar, Indian Ocean, under 65 fathoms. A larger specimen, 12 mm. in diameter, is said by Carter to be preserved in the British Museum; it was obtained from Kendrick Island, Japan (lat. 24° 13′ N., long. 136° 13′ E.).

Remark.—Carter does not state that the desma is monocrepid, and it is quite possible that it may be tetracrepid, in which case the sponge might be related to *Kaliapsis*, Bowerbank.

Corallistes elegantior, O. Schmidt.

Corallistes elegantior, O. Schmidt, Spong. Atlant. Gebiet., p. 23, pl. iii. fig. 5, 1870.
" " Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 439, 1873.
" " Zittel, Abhandl. d. k. baier. Akad. d. Wiss., pp. 103, 120, 1878.

Sponge.—A fragment.

Spicules.—I. Megascleres. 1. *Desma*, cladi long, slender. 2. *Dichotriæne*, cladi slender, smooth.

II. Microscleres (?).

Habitat.—Portugal.

Corallistes (?) *elegantissima*, Carter.

Corallistes elegantissima, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 144, pl. vii. fig. 47, 1880.

This species is founded on isolated desmas, occurring on a "Melobesian" nodule, from the Gulf of Manaar, at a depth of under 65 fathoms.

Corallistes microtuberculatus, O. Schmidt.

Corallistes microtuberculatus, O. Schmidt, Spong. Atlant. Gebiet., p. 23, pl. iii. fig. 4, 1870.
„ „ Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 439, 1873.
„ „ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., pp. 103, 120, pl. i. fig. 1, 1878.

Sponge.—An irregular curved disc. Oscules numerous, 1 mm. in diameter, margins elevated, occurring on the concave side.

Spicules.—I. Megascleres. 1. *Desma*, bearing large tubercles, which are themselves beset with secondary tubercles. 3. *Dichotriæne*, rhabdome strongylate, about 0·3 mm., chord of cladome about 0·2 mm. in length.

II. Microscleres. 4. *Microxea* (?). 5. *Spiraster.*

Habitat.—St. Iago, Cape Verde Islands ; depth (?).

Corallistes (?) *noli-tangere*, O. Schmidt.

Corallistes noli-tangere, O. Schmidt, Spong. Atlant. Gebiet., p. 23, pl. iii. fig. 6, 1870.
„ „ Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 439, 1873.
„ „ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., pp. 103, 120, pl. i. fig. 2, 1878.

Sponge.—Depressed, cup-shaped, walls thick, margin rounded, attached by a short thick pedicel. Oscules numerous, distributed over the inner surface ; pores on the interior.

Spicules.—I. Megascleres. 1. *Desma*, bearing numerous short cylindrical or conical tubercles with rounded ends. 2. *Dichotriæne*, rhabdome strongylate, about 0·55 mm. in length ; deuterocladi terminate in numerous rounded twig-like processes.

II. Microscleres. 3. *Microxea* (?) (Carter).

Habitat.—Portugal, St. Jago.

Remarks.—This species may possibly be referable to *Macandrewia ;* this is suggested by Carter's statement that the microsclere is a microxea ; the characters of the dichotriæne are not discordant with such a view.

Corallistes (?) *verrucosa* (Carter).

Corallistes verrucosa, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 144, pl. vii. fig. 46, 1880.

Sponge.—(?).

Spicules.—I. Megasclere. 1. *Desmas*, similar to those of the preceding species, *Corallistes* (?) *aculeata* (p. 338), but distinguished by the form of the apical ray, which is simple, conical, 0·0375 mm. in length by 0·03 mm. in diameter at the base, bearing large

tubercles, three larger than the rest occurring in the angles of the basal rays, and forming the greater part of the base of the apical ray. 2. *Triæne* (?).

II. Microscleres (?).

Habitat.—Gulf of Manaar, depth under 65 fathoms.

Remarks.—This, like *Corallistes* (?) *aculeata*, Carter, may prove to be a Tetracladine Lithistid, and allied to *Kaliapsis*, Bowerbank.

Genus 3. *Macandrewia*, Gray.

Corallistidæ in which the epirabd of the desma is smooth, zygosis is chiefly terminal; the ectosomal spicules are phyllotriænes and the microscleres are microrabds. The pores and oscules are simple.

Macandrewia azorica, Gray.

Macandrewia azorica, Gray, Proc. Zool. Soc. Lond., p. 438, pl. xv., 1859.
Dactylocalyx macandrewii, Bowerbank, Proc. Zool. Soc. Lond., p. 86, pl. iv. fig. 5; pl. v. figs. 1–5, 1869.
Macandrewia azorica, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. pp. 438, 441, 1873.
„ „ Carter, *op. cit.*, ser. 4, vol. xviii. p. 464, 1875.

Sponge.—Cyathiform, pedicelled, attached; walls somewhat thick, undulating longitudinally, margin rounded, sinuous; surface even. Oscules small, 0·25 to 2·0 mm. in diameter; circular, with slightly raised margins more or less regularly arranged on the inner surface of the cup. Pores small, circular, evenly dispersed on the outer surface, protected by microxeas arranged tent-like.

Spicules.—I. Megascleres. 1. *Desma*, protocladi usually smooth, syzygial spines somewhat long, conical, with rounded ends; syzygias arranged in long straight lines which run radially across the wall of the sponge. Two cladi of a desma frequently lie tangentially with the line of syzygias, and a third crosses from one line to the next transversely. Such a transverse cladus usually measures about 0·15 by 0·035 mm. 2. *Oxea*, fusiform, 1·0 by 0·016 mm., lying parallel to the syzygial lines. 3. *Phyllotriæne*, rhabdome conical, traversed by the axial fibre throughout, cladi narrow, foliate, the axial fibre extending into them for a distance of 0·0296 mm.; rhabdome 0·18 mm., cladi 0·25 mm. long.

II. Microscleres. 4. *Microxea*, fusiform, slightly curved, 0·065 by 0·004 mm.

Colour.—Nut-brown in the dried state. Size, 125 mm. in height, by 100 mm. in diameter.

Habitat.—St. Michael's, Azores (Gray); a few miles north of Cape St. Vincent; depth, 374 fathoms (Carter); between Färoe Islands and north coast of Scotland (Carter).

Macandrewia clavatella (O. Schmidt).

Corallistes clavatella, O. Schmidt, Spong. Atlant. Gebiet., p. 23, pl. iii. fig. 7, 1870.
Macandrewia azorica, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 438, 1873 ; vol. xviii. p. 464, 1876.
„ *clavatella*, Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 39, 57, pl. i. fig. 3, 1878.
Discodermia clavatella, O. Schmidt, Spong. Meerb. Mexico, p. 24, pl. iii. figs. 2, 3, 5, 1879.

Sponge.—Obconic, seated on a short pedicel, attached, summit flattened or depressed, or convexly rounded, bearing several oscules, 0·25 to 1·0 mm. in diameter, with margins slightly elevated or not ; or incrusting. General arrangement of the excurrent and incurrent canals as in *Jerea*. Pores 0·035 to 0·04 mm. in diameter, dispersed over the sides of the sponge, margins furnished with a fringe of microxeas which radiate up to the centre of the pore.

Spicules.—I. Megascleres. 1. *Desma*, protocladi usually smooth, about 0·05 by 0·019 mm. to 0·1 by 0·014 mm., syzygial tubercles short, well rounded ; axial rod of crepis from 0·0276 to 0·036 mm. in length. 2. *Oxea*, fusiform, slender, 0·39 by 0·013 mm. 3. *Phyllotriæne*, rhabdome and cladi each 0·13 in length ; the axial fibre which extends throughout the rhabdome does not proceed much beyond 0·015 mm. into the cladi.

II. Microsclere. 4. *Microxea*, fusiform, sometimes with an ellipsoidal centrotylus, usually curved, 0·055 by 0·004 mm. The microxeas form a single layer beneath the outer epithelium, fringe the pores, and extend throughout the sponge.

Colour.—Greyish-white.

Habitat.—Florida ; depth, 152 to 270 fathoms (Pourtalès, O. Schmidt). Gulf of Mexico ; depth, 131 fathoms (Agassiz, O. Schmidt, Stations 203, 210).

Remarks.—This species appears to me to be very clearly distinguished from *Macandrewia azorica*, Gray, with which Carter has identified it. Not only is the general form not the same, but the arrangement of the excurrent and incurrent canals, and the characters of the desmas, differ markedly. In *Macandrewia azorica* the syzygial spines are more or less conical, and tend to run out into long slender processes—Carter has compared them to the antlers of deer,—but in *Macandrewia clavatella* they are short and well rounded, and have no tendency to elongated growths.

O. Schmidt regards the desma as tetracrepid, since in some cases it presents a tetractinate axis, one of the actinal fibres being very long as compared to the other three ; at the same time he states that it is also frequently monocrepid, and hence concludes that the sponge presents evidence of a passage from the Tetracladine to the Rhizomorina type ; at the same time, regarding the characters of the discotriæne as of more importance than those of the desma, he assigns the sponge to the *Discodermia* group of the Tetracladina. An examination of one of the Mexican specimens on which Schmidt bases these statements enables me to confirm his observations in the fullest manner. The desmas

are characteristically monocrepid, and hence I refer the sponge to the Corallistidæ, but now and then one meets with a true skeletal desma in zygosis with its fellows, and presenting the additional three short actinal axes described by Schmidt. I was at first, from the rarity of this phenomenon, inclined to imagine that Schmidt might have been mistaken, but after considerable pains I obtained the clearest evidence to the contrary, and I am now convinced that a complete series of transitional forms connect the monocrepid and tetracrepid desmas.

Genus 4. *Dædalopelta*, n. gen.

Corallistidæ in which the desma and discotriæne are similar to those of *Macandrewia*, but the microscleres are spirasters.

Dædalopelta nodosa (O. Schmidt).

Discodermia clavatella, var. *nodosa*, O. Schmidt, Spong. Meerb. Mexico, p. 25, pl. iii. fig. 1, *n. o.*, 1879.

Sponge.—A small cushion-shaped mass, attached by an irregular base; surface somewhat rough, except over the base and sides, which are smooth and shining. Oscules numerous, small, simple openings collected within two shallow depressions on the upper surface, leading into small canals which radiate into the sponge in all directions, the most superficial visible beneath the skin, arranged in a branching stellate system.

Spicules.—I. Megascleres. 1. *Desma*, epirabd quadriradiate, triradiate, or more or less straight, smooth; cladi smooth or tuberculate; zygosis chiefly terminal. Maximum total length of a rectilinear form, 0·4 mm. Crepidial axis usually centrotylote, 0·047 mm. long, varying but slightly on each side of this to 0·043 and 0·051 mm., in one exceptional instance 0·095 mm. in length. 2. *Phyllotriæne*, cladome consisting of irregular narrow cladi, margins produced into bifid spines, or bifurcating tubercles which end in bifid spines; upper surface also tuberculated, the tubercles bearing from one to four bifid spines. Maximum diameter of the cladome, 0·35 mm. Rhabdome conical, strongylate, 0·05 to 0·1 mm. in length. The axial fibre of the cladi seldom more than 0·009 mm. in length. 3. *Oxea*, slender, cylindrical, 0·2 by 0·003 mm.

II. Microscleres. 4. *Spiraster*, variable in form, sometimes passing into an amphiaster, sometimes into a metaster, 0·0237 mm. in length; a single spine often 0·01 mm. long.

Colour.—Dark brown. Size, 33 mm. long by 26 mm. wide and 13 mm. high. The smooth basal surface extends up the sides for a distance of 3 mm.

Habitat.—Gulf of Mexico.

Remarks.—The smooth basal surface is produced by a layer of closely articulated

discotriænes overlying desmas, flattened in a plane parallel to the surface, and also closely articulated.

Palæontologists used to distinguish such basal membranes as "epitheca," and several fossil species of Lithistids could be cited as resembling *Discodermia nucerium* in the presence of this membrane, as well as in the characters of the desmas and canal-system.

Genus 5. *Heterophymia*, Pomel.

Corallistidæ with separate poriferous and oscular surfaces, which are distinguished by different ectosomal spicules, dichotriænes occurring on the poriferous, and small, smooth, irregularly branched desmas on the oscular surface.

Heterophymia heteroformis (Bowerbank).

Coscinospongia heteroformis, Valenciennes, MS.
Dactylocalyx heteroformis, Bowerbank, Proc. Zool. Soc. Lond., p. 85, pl. iv. figs. 1–4, 1869.
Heterophymia heteroformis, Pomel, Pal. de l'Oran, p. 143.
„ „ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 121, 1878.

Sponge.—Sessile, flabellate or foliate, sinuously plicated. Surface slightly undulating, minutely hispid. Oscules on the upper surface, slightly elevated and marginated, numerous, irregularly dispersed, 1 mm. in diameter. Pores congregated (in sieves ?), porous areas minute, slightly depressed, rarely more than their own diameter apart.

Spicules.—I. Megascleres. 1. *Desmas*, similar to those of *Corallistes*. 2. *Dichotriæne*, rhabdome long, curved; cladi short, thick. This spicule is confined to the poriferous surface. 3. *Strongyle*, large.

II. Microsclere (?).

Colour.—Dark brown in the dried state. Size, 125 mm. high, 113 mm. broad; wall 8 mm. thick.

Habitat.—Shanghai, China; depth (?) (Collection of the Jardin des Plantes).

Family III. Pleromidæ.

Genus 2 (?). *Lyidium*, O. Schmidt. *Incertæ sedis.*

Lyidium torquila, O. Schmidt.

Lyidium torquila, O. Schmidt, Spong. Atlant. Gebiet., p. 84, woodcut, 1870.
„ „ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 103, 132, pl. i. fig. 10, 1878.

Sponge.—A fragment, probably of a flat plate-like individual, 3 mm. in thickness. Oscules and pores similar, large, 0·5 to 1·0 mm. in diameter, round simple openings of transversely directed canals situated on opposite sides of the plate.

Spicules.—I. Megascleres. 1. *Desma*, smooth, similar to those of *Pleroma turbinatum*; cladi ending in disc- or cup-like expansions. 2. *Strongyle*, cylindrical, about 0·8 mm. in length.

II. Microscleres (?).

Habitat.—Cuba, Cozera; depth, 270 fathoms.

Remarks.—I have not seen this species, which is based on a fragment only 1 sq. cm. in area, and possibly not in possession of its full complement of spicules. Zittel states that the strongyles are distributed through the dermal layer. If the dermal layer is present in the specimen, as one would infer from this, we may conclude that triænes are absent.

Demus II. Rhabdosa.

Family I. Neopeltidæ.

Rhabdosa in which the ectosomal spicules are monocrepid discs.

Genus 1. *Neopelta*, O. Schmidt.

Neopeltidæ in which the microscleres are microrabds and spirasters.

Neopelta perfecta, O. Schmidt.

Neopelta perfecta, O. Schmidt, Spong. Meerb. Mexico, p. 88, pl. v. fig. 3, 1880.

Sponge.—An irregular rounded mass, constricted above the base, which is attached by a flattened surface. Oscules small, borne at the end of compressed papillary processes, sometimes concealed by a flap-like outgrowth, involving both ectosome and choanosome. Pores simple, oval, from 0·045 to 0·077 mm. in diameter. In addition to the oscules several small oval openings occur here and there over the surface, they lead into vestibular canals.

Spicules.—I. Megascleres. 1. *Desma*, cladi smooth, slender, frequently dichotomising, syzygial processes usually confined to the ends of the terminal cladi, zygosis simple, the syzygial tubercles and lobes are few. An average example measured, protocladus 0·127 by 0·019 mm., deuterocladus 0·0636 by 0·013 mm., tritocladus 0·0636 by 0·013 mm., length of compound cladus 0·24 mm.; crepis 0·0513 mm. in length. 2. *Oxea*, slender, cylindrical, curved simply or irregularly, distributed singly or in bundles, which run parallel with the course of the larger canals, 0·54 by 0·008 mm. 3. *Ectosomal disc*, more or less oval in outline, rarely presenting a central process directed

at right angles to its surface, 0·17 mm. in diameter, immeasurably thin, crepis 0·04 mm. in length, when a stalk-like process is present, its diameter does not exceed 0·008 mm.

II. Microscleres. 4. *Somal microxea*, fusiform, slightly curved, surface minutely roughened, 0·055 by 0·004 mm. 5. *Choanosomal amphiaster*, a slender, straight axis, and a whorl of several slender, hair-like actines near each end, total length 0·0118 mm., length of a single actine about 0·004 mm.

The microxeas are distributed tangentially in a layer beneath the outer epithelium, overlying the layer of discs; they also extend throughout the sponge in such numbers as to constitute almost as considerable a part of the skeleton as the desmas. The amphiasters appear to occur only in the choanosome, and are not abundant even there.

Colour.—Yellowish-grey in spirits. Size, 35 mm. in height by 25 mm. in maximum diameter.

Habitat.—Locality not given by Schmidt; the sponge bears a label "Ag. 79, 134," and the bottle a metal foil with the number 255.

Remarks.—The skeleton of this sponge is the loosest and most fragile of all the Lithistids, and no species probably is better fitted for minute histological examination, unless possibly *Discodermia dissoluta*. It was to be expected that thin slices would furnish interesting results, but unfortunately the soft parts of the specimen are not sufficiently well preserved to exhibit structure.

Neopelta imperfecta, O. Schmidt.

Neopelta imperfecta, O. Schmidt, Spong. Meerb. Mexico, p. 88, pl. ix. fig. 11, 1880.

Sponge.—Small, papilla-like, compressed at the upper end, and produced into small oscular tubes. Longitudinal canals visible beneath the surface, running the whole length of the sponge. Pores simple (one measured 0·065 mm. in diameter).

Spicules.—I. Megascleres. 1. *Desma*, epirabd smooth, more or less straight, or curved, or triradiate, crepidial axis 0·04 mm. in length, zygosis by rounded tubercles, chiefly terminal.

2. *Disc*, more or less oval in outline, margin entire or lobate, sometimes notched by a rhabdal sinus, under surface impressed by the underlying discs; maximum diameter 0·35 mm. Crepidial strongyle either wholly or partly immersed in the disc, when only partly immersed projecting as a shaft from the lower surface. Crepidial axis from 0·04 to 0·087 mm. in length. 3. *Rhabdus* (*?*).

II. Microscleres. 4. *Microxea*, fusiform, sharply pointed, smooth, slightly curved, 0·071 by 0·004 mm. 5. *Amphiaster*, small, actines few, 0·0118 mm. in length.

Colour.—Dark-brown. Size, the largest specimen is 10 mm. in length, by 4 mm.

in diameter at the base, which is broken; the oscular tubes do not exceed 1 mm. in diameter.

Habitat.—Barbados; depth, 103 fathoms.

Remarks.—A small specimen nearly 3 mm. in diameter, presents in transverse section the cut ends of six longitudinal canals, bounded towards the interior and laterally by the desmose skeleton, and on the exterior by the layer of discs; no other distinct canals were seen. The longitudinal canals are seen below the discs when the ectosomal layer is viewed *en face*, they are crossed by velar diaphragms, and are evidently subdermal or ectosomal in the strictest sense. Although portions of the ectosome measuring altogether about 4 mm. square were prepared with a view to examining the pores, only one pore was found.

The appearance of the skeleton is very tetracladine, but the desmas are all strictly monocrepid.

Family II. Scleritodermidæ.

Genus 1. *Scleritoderma*, O. Schmidt.

Scleritoderma packardi, O. Schmidt.

Scleritoderma paccardi, O. Schmidt, Spong. Meerb. Mexico, p. 28, pl. ii. fig. 3, 1879.

Sponge.—A short wide cylinder with rounded edges, constricted above the flattened attached base, and depressed at the summit into a bowl-shaped cavity; in other words, a depressed bowl-shaped sponge with thick walls and an expanded base. Oscules regularly distributed over the interior of the cup, opening at the summits of small rounded tubercle-like elevations, surrounded by a thick sphincter of concentrically arranged myocytes, 0·1 to 0·15 mm. in diameter. Pores regularly distributed over the outer surface, simple, situated at the bottom of shallow circular depressions, about 0·13 mm. in diameter, closed by a sphincter of concentric myocytes. Surface smooth, in the neighbourhood of the pores very sparingly hispidated by an occasional oxea, which extends 0·5 mm. beyond the skin.

Spicules.—I. Megascleres. 1. *Desma*, cladi highly tuberculate, zygosis close, dense, occurring along the sides as well as at the terminations of the cladi. 2. *Oxea*, cylindrical, slender, only slightly curved, 1·2 by 0·015 mm.

II. Microscleres. 3. *Microstrongyle*, irregularly fusiform, depressed, 0·17 by 0·013 mm. 4. *Sigmaspire*, 0·014 mm. long.

The microstrongyles form a dense layer beneath the outer epithelium, lying tangentially, with their depressed surfaces parallel to the exterior; they also occur throughout

the sponge, and near the larger canals lie tangentially to their walls. The sigmaspires occur throughout the sponge. The margins of the sphincters of the oscules and the pores are bounded by the microstrongyles of the dermal layer, and the exposed surfaces of the sphincters show beneath the epithelium numerous sigmaspires.

Colour.—(?). Size, 18 mm. in diameter by 12 mm. in height.

Habitat.—Station 307, Agassiz.

Remarks.—This sponge is very clearly distinguished from *Scleritoderma flabelliformis* from the Ki Islands, partly by the general form, and partly by the size of the microstrongyles, which are twice the length of those in the latter species.

Genus 2. *Aciculites*, O. Schmidt.

Scleritodermidæ in which the ectosomal spicules are rhabdi; microscleres are absent.

The occurrence of an ectosomal layer of rhabdi suggests an alliance with *Scleritoderma*; and since, judging from the Tetillidæ, the sigmaspire is an inconstant spicule, its absence is not a matter of such importance as to exclude the genus from the Scleritodermidæ.

Aciculites higginsi, O. Schmidt.

Aciculites higginsi, O. Schmidt, Spong. Meerb. Mexico, p. 29, pl. ii. figs. 1, 4, 13, 1879.

Sponge.—Cushion-shaped, attached either by the entire base or by its margin only; in the latter case the middle of the base rises upwards, so as to leave a large hollow cavity between it and the surface of attachment. Oscules one or several, seated on the summit of slight conical elevations or in slight depressions, forming the centre of a stellate system of superficial canals, which can be traced as ramifying dark-coloured lines beneath the surface, provided with a sphinctrate margin, protected by a tent-like arrangement of rhabdi, which radiate from the circumference towards the centre. Pores simple, 0·03 mm. in diameter.

Spicules.—I. Megascleres. 1. *Desma*, small; cladi short, thick, richly tuberculate, protocladi 0·065 by 0·026 mm. to 0·084 by 0·039 mm. 2. *Rhabdus*, variable, usually a tylotostrongyle, the tylus scarcely thicker than the rhabdome, minutely spined; rhabdome smooth, cylindrical, curved; sometimes a strongyle, sometimes, but very rarely, a tylotoxea, 0·271 by 0·01 mm. to 0·355 by 0·01 mm., but variable, sometimes much shorter.

II. Microscleres absent.

Beneath the external epithelium the rhabdi form a single layer lying tangentially; they also occur directed at right angles to the surface, with the tylus directed outwards

and in contact with the epithelium, and are generally distributed through the choanosome, in the walls of the chief canals lying tangentially.

Colour.—(?), probably originally cream-yellow, now stained with magenta. Size, about 30 mm. in length by 15 mm. in height.

Habitat.—Off Havanna; depth, 100 fathoms.

Remarks.—This sponge presents a very close superficial resemblance to *Cnemidiastrum pluristellatum*, Zittel (Lithistidæ, p. 110, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i., 1878; *Cnemidium stellatum*, Quenst., Jura, p. 676, pl. cxxviii. figs. 6, 7). The oscules, with the associated superficial canals, and the short, much tuberculated desmas, are similar in both.

Family III. Cladopeltidæ.

Genus 1. *Siphonidium*, O. Schmidt.

Siphonidium ramosum, O. Schmidt.

Leiodermatium ramosum, O. Schmidt, Spong. Atlant. Gebiet., p. 21, pl. iii. fig. 1, 1870.
" " Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 439, 1873.
" " Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. p. 103, 1878.
Siphonidium ramosum, O. Schmidt, Spong. Meerb. Mexico, p. 28, pl. i. fig. 8, 1879.
Leiodermatium ramosum, Vosmaer, Bronn's Thierreichs, Bd. ii., Porifera, p. 290, 1885.

Sponge.—Similar to *Siphonidium capitatum.*

Spicules.—1. Megascleres. 1. *Desmas*, similar to those of *Siphonidium capitatum.* 2. *Oxystrongyle*, style-like, strongylate termination finely granulated, 0·45 by 0·02 mm.

Habitat.—Florida, 125 fathoms; Sombrero, 240 fathoms; Morro Light, 212 fathoms.

Remarks.—The similarity of *Siphonidium ramosum* and *Siphonidium capitatum* has already been commented on. It only remains to add a few words in explanation of the change in the generic name. The genus *Leiodermatium*, as founded by O. Schmidt, originally included two species generically different, *Leiodermatium ramosum*, O. Sch., and *Leiodermatium lynceus*, O. Sch.; on recognising this Schmidt proposed the new name *Siphonidium* for the species *Leiodermatium ramosum*, Zittel (*loc. cit.*, p. 122) having previously redefined the genus *Leiodermatium* on the type of *Leiodermatium lynceus*, O. Sch. Vosmaer objects to this nomenclature and states that as *Leiodermatium ramosum* was the first-described species, it must stand as the type of *Leiodermatium*, and a new generic name must be found for *Leiodermatium lynceus.* This seems to me hypercritical. Schmidt's two species were described, one immediately after the other, in the same publication, and neither was specially indicated as the type; an author has of

course the privilege of selecting his own type, and Schmidt simply postponed his selection; no one in the meantime had assigned further species to the genus *Leiodermatium*, and no possible inconvenience can result from accepting Schmidt's nomenclature.

Suborder II. ANOPLIA.

Family I. AZORICIDÆ.

Genus 1. *Azorica*, Carter.

Azorica chonellides, Döderlein.

Seliscothon chonelleides, Döderlein, Zeitschr. f. wiss. Zool., Bd. xl. p. 62, pl. v.–vii., 1884.

Sponge.—Ear-shaped, somewhat curved, free edge a regular semicircle, uniformly rounded; attached by thin lobe-like expansions. Pores and oscules similar, small, dispersed; pores on the outer convex surface placed much closer together than the oscules, which are confined to the inner surface.

Spicules.—I. Megascleres. 1. *Desma*, epirabd straight or curved, cladose at one or both ends, densely and irregularly spined and tuberculate. 2. *Oxea* or *Strongyloxea*, long and slender, arranged in fibres, descending from the surface at right angles into the interior.

Colour.—Greyish-white (but deciduous?). Size, 60 mm. wide by 55 mm. high and 7 mm. thick.

Habitat.—Island of Enoshima, Bay of Sagami.

Genus 3. *Gastrophanella*, O. Schmidt.

Azoricidæ in which a single oscule leads into a long axial cloaca; the excurrent and incurrent canals are arranged as in *Siphonia*.

Gastrophanella implexa, O. Schmidt.

Gastrophanella implexa, O. Schmidt, Spong. Meerb. Mexico, p. 29, pl. i. fig. 7, pl. iii. fig. 8, 1879.

Sponge.—Elongated, pear-shaped or club-shaped, attached by an expanded irregular base; oscule, single, situated at the summit, leading into a long narrow cloaca which extends throughout the axis of the sponge. Cloaca with a somewhat thick collenchymatous wall, and numerous not very extended velar diaphragms. Excurrent canals, curving more or less parallel to the outer surface of the sponge, run longitudinally

upwards to open freely into the cloaca; incurrent canals radiating from the general surface towards the cloaca.

Spicules.—I. Megascleres. 1. *Desma*, small; epirabd somewhat straight or triradiate, frequently straight and bifurcate at each end, bearing conical spines; cladus of a triradiate form, 0·1 by 0·019 mm.; crepidial axis short, from 0·01 to 0·0275 mm. in length; zygosis general, but chiefly terminal. 2. *Tylostrongyle*, slender, cylindrical, 0·48 by 0·005 mm.

Colour.—Brown.

Habitat.—West Indian Islands; lat. 25° 23′ N., long. 83° 31′ W.; depth, 101 fathoms. Lat. 22° 9′ 15″ N., long. 82° 20′ 80″ W.; depth, 127 fathoms.

Remarks.—The water-canals are lined by a thick layer of collenchyma, in which desmas do not occur; microscleres if present would certainly be found here, and as they are not their absence has been positively ascertained. The collenchymatous walls resemble those of *Theonella* (Pl. XXX. figs. 9, 10) and other Lithistids.

The tylostrongyles occur in bundles throughout the sponge; near the surface they are directed at right angles to the epithelium, against which the tylote ends of the most external of them abut. They are never arranged tangentially to form an ectosomal layer.

The surface of attachment is covered by a smooth shining layer produced by modified desmas.

Genus 4. *Setidium*, O. Schmidt.

Diagnosis not given.

Setidium obtectum, O. Schmidt.

Setidium obtectum, O. Schmidt, Spong. Meerb. Mexico, p. 30, pl. i. fig. 9, pl. ii. fig. 14, 1879.

Sponge.—Cyathiform, with thick walls and rounded edges, attached by an expanded base. Inner and outer surfaces, but not the edge of the cup, bearing numerous, more or less regularly arranged, somewhat conical processes, each bearing a bundle of about sixteen to eighteen long oxeas. Each process covers the end of a canal, which is lined by a layer of similar oxeas.

Spicules.—I. Megascleres. 1. *Desmas*, densely tuberculated, forming a more than usually hard and stony skeleton. 2. *Oxea*, long.

Habitat.—Near Havanna; depth, 128 to 240 fathoms.

Remark.—I have not seen this sponge, so that I am unable to give an account of the skeleton.

Genus 5. *Poritella*, O. Schmidt.

Founded on a deciduous specimen; generic characters not assignable.

Poritella decidua, O. Schmidt.

Poritella decidua, O. Schmidt, Spong. Meerb. Mexico, p. 27, 1879.

Sponge.—Irregularly fan-shaped or vasiform, attached; walls thick, upper margin flat, smooth; inner surface covered with small circular oscules, less than 0·5 mm. in diameter; outer surface covered with pores, visible to the unaided eye.

Spicules.—I. Megascleres. 1. *Desma*, large, very irregular in form, covered with large cylindrical and conical tubercles; zygosis is lateral as well as terminal. The axial fibre of the crepis measures 0·044 mm. in length, the entire desma 0·5 mm. from end to end. 2. *Rhabdus*, slender, cylindrical; termination (?).

II. Microsclere (?). The specimens are deciduous.

Size of fan-shaped specimen sent me by Professor Agassiz, 35 mm. in height and 32 mm. in maximum breadth, walls 10 mm. in thickness.

Habitat.—Various localities in the Gulf of Mexico; 100 to 805 fathoms.

Remarks.—This sponge very closely resembles in general appearance *Corallistes typus*, O. Schmidt; it differs, according to Schmidt's description, in the absence of triænes.

Genus 6. *Amphibleptula*, O. Schmidt.

Azoricidæ with a single oscule at the summit, and poriferous areas borne at the ends of short cylindrical processes, irregularly and generally distributed over the sides.

Amphibleptula madrepora, O. Schmidt.

Amphibleptula madrepora, O. Schmidt, Spong. Meerb. Mexico, p. 28, pl. i. fig. 6; pl. iii. fig. 7, 1879.

Sponge.—Conical, with rounded sides, attached by a flattened or concave base, at the summit a flattened area about 6 mm. wide, presenting vertical radiating septa about twelve to thirteen in number, surrounding a central cavity about 1·5 mm. in diameter, into this and the cavities between the septa open numerous more or less vertical tubes. The sides for 5 or 6 mm. from the summit are plain and even, but beyond this covered with numerous, not very regularly arranged, cylindrical processes, 1 to 2 mm. in diameter, traversed by one or more tubes, which open by septate apertures at the end. These represent the incurrent openings, that at the summit the oscule.

Spicules.—I. Megascleres. 1. *Desma*, epirabd curved, semicircular, or straight or triradiate, rarely quadriradiate, bearing spined tubercles, in the curved forms on the convex side; zygosis general. A semicircular form measured 0·24 mm. along the diameter, and 0·038 mm. in thickness; a more or less straight form 0·38 mm. in length; crepidial axis 0·04 mm. in length. 2. *Rhabdus*, 0·0065 mm. in diameter, length and nature of termination not determined.

Colour.—In the dried state, greyish-white. Size, 18 mm. in diameter by 20 mm. in height.

Habitat.—Barbados; depth, 100 fathoms. Havanna; depth, 292 fathoms.

Genus 7. *Tremaulidium*, O. Schmidt.

Diagnosis included in the specific description.

Tremaulidium geminum, O. Schmidt.

Tremaulidium geminum, O. Schmidt, Spong. Meerb. Mexico, p. 31, pl. ii. figs. 1*a–l*, fig. 2; pl. iv. figs. 1, 2, 1879.

Sponge.—Irregular, with a flat base, incrusting, produced into vertical conical processes, with rounded or compressed chisel-like ends; traversed by numerous vertical tubes; surface covered with a very finely ridged outer layer (cuticula?).

Spicules.—Desma and rhabdus.

Habitat.—Lat. 25° 33′ N., long. 83° 1′ W.; depth, 131 fathoms.

Remarks.—This sponge, which I have not seen, is possibly nearly related to *Siphonidium ramosum*.

Genus 8. *Leiodermatium*, O. Schmidt.

Azoricidæ of vasiform shape, with comparatively large oscules situated on the outer surface; pores distributed over the inner surface.

Leiodermatium lynceus, O. Schmidt.

Leiodermatium lynceus, O. Schmidt, Spong. Atlant. Gebiet., p. 22, pl. iii. fig. 2, 1870.
" " Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 439, 1873.
" " Zittel, Abhandl. d. k. baier. Akad. d. Wiss., pp. 103, 122, pl. i. fig. 5, 1878.

Sponge.—An irregularly curved plate or hollow cylinder, with deeply incised margin. Oscules circular, 0·5 to 0·75 mm. in diameter, opening on the summit of quite flat

papilla, situated on the outside of the sponge, 1 to 2 mm apart. Pores small, scattered over the inner surface.

Habitat.—Portugal and St. Jago (O. Schmidt).

Genus 9. *Sympyla*, n. gen.

Azorica, in part, O. Schmidt, Spong. Meerb. Mexico, p. 89.

Azoricidæ in which the poral terminations of the incurrent canals are collected together into separate areas, which are distributed over one side of the sponge; the oscules are simple, and are distributed over the side opposite to that bearing the pores.

I refer this genus to the Azoricidæ on general grounds, as the specimen on which it is founded is deciduous. We do not know whether microscleres were present or not.

Sympyla cribrifera (O. Schmidt).

Azorica cribriphora, O. Schmidt, Spong. Meerb. Mexico, p. 89, pl. v. fig. 4, 1880.

Sponge.—Vasiform, walls thick, margins rounded, central cavity somewhat shallow; pedicel short, base slightly enlarged, attached. Oscules numerous, circular, 1 mm. in diameter, with margins elevated or produced into short tubes, distributed in more or less regular spiral lines, leading into more or less vertically descending canals. Pores not seen, poriferous areas raised above the general surface, rendered cribriform by the numerous openings of narrow incurrent canals from 0·2 to 0·5 mm. in diameter.

Spicules.—I. Megascleres. 1. *Desma* of the usual "azorica" forms. The epirabd usually smooth, 0·045 mm. in diameter; syzygial tubercles frequently bearing bifid spines, with papillary ends, syzygial lamellæ frequently minutely crenate or denticulate at the distal margin. Crepidial axis from 0·04 to 0·05 mm. in length. 2. *Tylote* (?), cylindrical, with very slightly enlarged ends, which are sometimes minutely roughened, 0·35 by 0·01.

II. Microscleres (?).

The specimen is a skeleton denuded of all soft parts; it is therefore doubtful whether the tylote really belongs to it, still more doubtful whether microscleres were originally present or not.

Colour.—(?). Size, in height 54 mm.; major and minor axes of the margin of the cup 47 mm. and 35 mm. respectively; depth of the central cavity 20 mm., walls 10 mm. in thickness; pedicel 15 mm. in diameter.

Habitat.—Barbados; depth, 200 fathoms.

Family II. Anomocladidæ, Zittel.

Anoplia in which the desma is acrepidal, a variable number of smooth, cylindrical cladi radiate from a thickened centrum; zygosis occurs between the expanded ends of the cladi of one desma and the centrum of another.

Vetulina stalactites, O. Schmidt.

Vetulina stalactites, O. Schmidt, Spong. Meerb. Mexico, p. 19, pl. i. fig. 1; pl. ii. fig. 9, 1879.
" " Sollas, Ann. and Mag. Nat. Hist., ser. 5, vol. xv. p. 236; Proc. Roy. Irish Acad., ser. 2, vol. iv. p. 486, 1885.

Sponge.—A sinuous folded plate, more or less cup-like, attached, surface of both sides even, meeting a flat upper margin at right angles, outer surface marked by concentric lines of growth; pores and oscules both small, the latter generally distributed on the inner face, the former over the outer. Wall from 5 to 20 mm. in thickness; consistence of stony hardness.

Spicules.—I. Megascleres. 1. *Desma*, cylindrical cladi seldom bifurcating, varying from two to eight in number, smooth, or bearing rounded or irregular tubercles, terminating in expanded syzygial ends, 0·1 to 0·15 by 0·012 to 0·02 mm.; centrum massive, 0·05 to 0·07 mm. in diameter; when the cladi are less than six in number, produced into numerous branching twig-like processes from the distal face. 2. *Strongyle*, cylindrical, 0·35 by 0·004 mm.

The desmas are arranged with the acladose face of the centrum turned towards the outer surface of the sponge, and the cladi extended in the opposite direction; they terminate by abutting on the acladose face of the centra of the next succeeding layer, and thus form a series of groin-like arches.

Habitat.—Barbados; depth, 100 fathoms (O. Schmidt). Probably also from shallow water, since a specimen exists in the Bristol Museum that was obtained long before the dredge was generally used for collecting, certainly before it was used in deep water.

GEOGRAPHICAL AND BATHYMETRICAL DISTRIBUTION.

LIST OF LOCALITIES AT WHICH TETRACTINELLID SPONGES WERE OBTAINED, WITH THE SPECIES OBTAINED AT EACH.

Off the coast of Portugal.

Corallistes bowerbanki.

Station IV. West of Gibraltar, January 16, 1873; lat. 36° 25′ N., long. 8° 12′ W.; depth, 600 fathoms; bottom, blue mud.

Thenea schmidtii.

Station 24. Off Culebra Island, March 25, 1873; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; West Indies; depth, 390 fathoms; bottom, Pteropod ooze. Dredged.

Craniella schmidtii. | *Thenea schmidtii.*

Station 33. Off Bermuda, April 4, 1873; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud. Dredged.

Azorica pfeifferæ.

Station 56. Off Bermuda, May 29, 1873; lat. 32° 8′ 45″ N., long. 64° 59′ 35″ W.; depth, 1075 fathoms; bottom, coral mud; bottom temperature, 38°·2. Dredged.

Isops pachydermata. | *Azorica pfeifferæ.*

Bermuda, West Indies.

Pilochrota tenuispicula.

Station 73. Off the Azores, June 30, 1873; lat. 38° 30′ N., long. 31° 14′ W.; depth, 1000 fathoms; bottom, Pteropod ooze; bottom temperature, 39°·4. Dredged.

Thenea schmidtii.

Station 78. Azores, July 10, 1873; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud. Dredged.

Tetilla sandalina.

St. Iago, Porto Praya, Cape Verde Islands, August 1873; depth, 100 to 128 fathoms.

Pœcillastra crassiuscula.
Sphinctrella gracilis.
Sphinctrella cribrifera.
Sphinctrella ornata.
Calthropella simplex.
Corallistes masoni.

Azorica pfeifferæ.

Station 106. Atlantic, south-west of Sierra Leone, August 25, 1873; lat. 1° 47′ N., long. 24° 26′ W.; depth, 1850 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·6. Trawled.

Thenea fenestrata.

St. Paul's Rocks, August 29, 1873. Taken with a fishing line from the shore.

Pilochrota gigas.

Station 122. Off Pernambuco, September 10, 1873; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud. Trawled.

Characella aspera.
Corallistes typus.

Station 122B. Off Barra Grande, Brazil, September 10, 1873; lat. 9° 9′ S., long. 34° 53′ W.; depth, 32 fathoms; bottom, red mud. Trawled.

Synops neptuni.

Station 122C. Off Barra Grande, Brazil, September 10, 1873; lat. 9° 10′ S., long. 34° 49′ W.; depth, 400 fathoms; bottom, red mud. Trawled.

Synops vosmaeri.

Station 123. Off Macio, September 11, 1873; lat. 10° 9′ S., long. 35° 11′ W.; depth, 1715 fathoms; bottom, red mud; bottom temperature, 37°.

Thenea fenestrata.

Off Bahia, September 1873.

Craniella carteri.
Samus anonymus.
Pilochrota crassispicula, 7–12 fathoms.
Pilochrota anancora, 7–20 fathoms.
Tribrachium schmidtii, 7–20 fathoms.
Erylus formosus, 7–20 fathoms.
Caminus sphæroconia, shallow water.
Cydonium glariosus, 7–25 fathoms.

Azoricâ pfeifferæ.

Station 135c. Nightingale Island, Tristan da Cunha, October 17, 1873; lat. 37° 25′ 30″ S., long. 12° 28′ 30″ W.; depth, 110 fathoms; bottom, hard ground, shells, and gravel. Dredged.

Pachastrella abyssi.

Station 147. Between Prince Edward Island and Crozet Islands, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; depth, 1600 fathoms; bottom, Diatom ooze; bottom temperature, 34°·2. Trawled.

Thenea delicata.

Station 149b. Off Royal Sound, Kerguelen, January 17, 1874; lat. 49° 28′ S., long. 70° 30′ E.; depth, 25 fathoms; bottom, volcanic mud. Dredged.

Tetilla grandis. | *Cinachyra barbata.*

Station 149c. Balfour Bay, Kerguelen, January 19, 1874; lat. 49° 32′ S., long. 70° 0′ E.; depth, 60 fathoms; bottom, volcanic mud. Dredged.

Cinachyra barbata.

Station 149h. Off Cumberland Bay, Kerguelen, January 29, 1874; lat. 48° 45′ S., long. 69° 14′ E.; depth, 127 fathoms.

Tetilla grandis, var. *alba.*

Kerguelen, January 1874; depth, 10 to 100 fathoms.

Tetilla grandis.

Station 150. West of Heard Island, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; depth, 150 fathoms; bottom, coarse gravel; bottom temperature, 35°·2. Dredged.

Tetilla coronida. | *Pœcillastra schulzii.*

Tetilla grandis, var. *alba.*

Station 161. Off Melbourne, April 1, 1874; lat. 38° 22′ 30″ S., long. 144° 36′ 30″ E.; depth, 33 fathoms; bottom, sand. Trawled.

Anthastra parvispicula.

Station 162. Off East Moncœur Island, Bass Strait; April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells. Dredged.

Anthastra communis. | *Pilochrota lendenfeldi.*

Psammastra murrayi.

Station 163a. Off Twofold Bay, Australia, April 4, 1874; lat. 36° 59′ S., long. 150° 20′ E.; depth, 150 fathoms; bottom, green mud. Trawled.

Chrotella simplex.
Craniella pulchra.
Anthastra pulchra.
Anthastra communis.

Station 164c. Off Sydney, June 13, 1874; lat. 34° 19′ S., long. 151° 31′ E.; depth, 400 fathoms; bottom, green mud; bottom temperature, 40°. Dredged.

Thenea grayi.

Port Jackson, June 3, 1874; depth, 6 to 15 fathoms.

Anthastra communis.
Cydonium eosaster.

Port Jackson, Sydney, June 3, 1874; depth, 30 to 35 fathoms.

Craniella simillima.
Anthastra pyriformis.
Anthastra ridleyi.
Stryphnus niger.
Synops nitida.
Discodermia discifurca.

Station 173. Off Matuka, Fiji Islands, July 24, 1874; lat. 19° 9′ 35″ S., long. 175° 11′ 0″ E.; depth, 315 fathoms; bottom, coral mud. Dredged.

Neosiphonia superstes.
Pleroma turbinatum.

Api, New Hebrides.

Amphius huxleyi.

Station 177. Off Api, New Hebrides, August 18, 1874; lat. 16° 45′ S., long. 168° 7′ W.; depth, 130 fathoms; bottom, volcanic mud. Dredged.

Thrombus challengeri.

Torres Strait, Cape York, August, 1874; depth, 3 to 11 fathoms.

Pilochrota purpurea, var. *longancora.*
Pilochrota moseleyi.
Disyringa dissimilis.
Tetilla merguiensis.

Station 186. Off Cape York, Torres Strait, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; bottom, coral mud. Dredged.

Craniella simillima, var. *b.*
Myriastra simplicifurca.
Myriastra clavosa.

Station 188. Arafura Sea, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; depth, 28 fathoms; bottom, green mud. Dredged and trawled.

Disyringa dissimilis.

Station 192. Off the Ki Islands, September 26, 1874; lat. 5° 49′ 15″ S., long. 139° 42′ 0″ E.; depth, 129 fathoms; bottom, blue mud. Trawled.

Triptolemus cladosus.
Cydonium hirsutus.
Azorica marginata.
Callipelta ornata.
Discodermia simillima.
Corallistes thomasi.
Scleritoderma flabelliformis.
Siphonidium capitatum.

Tretolophus paniceus.

Station 194a. Off Banda Island, October 29, 1874; lat. 4° 31′ 0″ S., long. 129° 57′ 20″ E.; depth, 360 fathoms; bottom, volcanic mud. Trawled.

Theonella sp.

Amboina, October, 1874; depth, 15–100 fathoms.

Pœcillastra laminaris (100 fathoms).
Azorica pfeifferæ (15–25 fathoms).

Station 196. Between Amboina and Samboangan, Philippine Islands, October 13, 1874; lat. 0° 48′ 30″ S., long. 126° 58′ 30″ E.; depth, 825 fathoms; bottom, hard ground; bottom temperature, 36°·9. Trawled.

Tetilla pedifera.

Samboangan, Philippine Islands; depth, 10 fathoms.

Pilochrota haeckeli.

Station 203. Off Panay, Philippine Islands, October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; depth, 20 fathoms; bottom, mud. Trawled.

Myriastra toxodonta.

Station 208. Off Manila, Philippine Islands, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; depth, 18 fathoms; bottom, blue mud. Trawled.

Chrotella macellata.
Theonella swinhoei.

Myriastra clavosa.

Station 209. Off Zebu, Philippine Islands, January 22, 1875; lat. 10° 14′ N., long. 123° 54′ E.; depth, 95 fathoms; bottom, blue mud. Trawled and dredged.

Thenea wyvillii.

Station 212. Celebes Sea, Philippine Islands, January 30, 1875; lat. 6° 54′ N., long. 122° 18′ E.; depth, 10 fathoms; bottom, sand. Trawled and dredged.

Myriastra clavosa, var. *quadrata.*

Station 218. Off New Guinea, March 1, 1875; lat. 2° 33′ S., long. 144° 4′ E.; depth, 1070 fathoms; bottom, blue mud; bottom temperature, 36·4. Trawled.

Thenea sp. (*wyvillii?*).

Kobé, Japan, June, 1875; depth, 8 to 50 fathoms.

Myriastra subtilis.

Station 236. South of Japan, June 5, 1875; lat. 34° 58′ N., long. 139° 29′ E.; depth, 775 fathoms; bottom, green mud; bottom temperature, 37°·6. Trawled.

Tetilla sp. | *Pœcillastra tenuilaminaris.*

Reefs off Tahiti; depth, 30 to 70 fathoms.

Pilochrota pachydermata.

Station 297. South-west of Juan Fernandez, November 11, 1875; lat. 37° 29′ S., long. 83° 7′ W.; depth, 1775 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·5. Trawled.

Thenea sp. (*wrightii?*).

Station 302. Off the west coast of South America, December 28, 1875; lat. 42° 43′ S., long. 82° 11′ W.; depth, 1450 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·6. Trawled.

Thenea wrightii.

Station 308. Off Tom Bay, Patagonia, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ 0″ W.; depth, 175 fathoms; bottom, blue mud. Trawled.

Astrella vosmaeri. | *Stelletta phrissens.*

Cydonium magellani.

STATION 311. Port Churruca, Patagonia, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ 0″ W.; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46°. Trawled.

Cydonium magellani.

STATION 320. Off Monte Video, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2. Trawled.

Tetilla leptoderma.

Locality unknown.

Discodermia ornata. | *Azorica crassiuscula.*

TABLE OF SPECIES OBTAINED BY THE CHALLENGER, SHOWING THEIR GEOGRAPHICAL AND BATHYMETRICAL RANGE.

	N. Atlantic.	S. Atlantic.	Southern Ocean.	W. Pacific.	E. Pacific.	0–50.	51–200.	201–1000.	1001–2000.
Tetilla sandalina,	×						×		
,, *leptoderma*,		×						×	
,, *pedifera*,				×				×	
,, *coronida*,			×				×		
,, *grandis*,			×			×	×		
,, ,, var *alba*,			×				×		
,, *merguiensis*, Carter,				×		×			
,, sp.,				×				×	
Chrotella simplex,				×			×		
,, *macellata*,				×		×			
Cinachyra barbata,			×			×	×		
Craniella similima, Bwk.,				×		×			
,, *carteri*,		×							
,, *pulchra*,				×		×			
,, *schmidtii*,	×							×	
Samus anonymus, Gray,		×							
Thenea delicata,			×						×
,, *wrightii*,		×							×
,, *grayi*,				×				×	
,, *schmidtii*,	×							×	
,, *fenestrata*, O. Schmidt,	×	×							×
,, *wyvillii*,				×			×		
Pœcillastra schulzii,			×				×		
,, *crassiuscula*,	×						×		
,, *laminaris*,				×				×	
,, *tenuilaminaris*,				×				×	
Sphinctrella cribrifera,	×						×		
,, *gracilis*,	×						×		
,, *ornatus*,	×						×		
Characella aspera,		×						×	
Triptolemus cladosus,				×			×		
Pachastrella abysii, O. Schmidt,		×					×		
Calthropella simplex,	×						×		
Myriastra subtilis,				×		×			
,, *simplicifurca*,				×		×			
,, *clavosa*, Ridley,				×		×			
,, ,, var. *quadrata*,				×		×			
,, *toxodonta*,				×		×			
Pilochrota haeckeli,				×		×			
,, *pachydermata*,				×		×	×		
,, *gigas*,	×					×			
,, *tenuispicula*,	×								
,, *crassispicula*,		×				×			
,, *purpurea*, var. *longancora*,				×		×			
,, *anancora*,		×				×			
,, *moseleyi*,				×		×			
,, *lendenfeldi*,				×		×			

	N. Atlantic.	S. Atlantic.	Southern Ocean.	W. Pacific.	E. Pacific.	0–50.	51–200.	201–1000.	1001–2000.
Astrella vosmaeri,					×		×		
Anthastra pulchra,				×			×		
„ *communis*,				×		×	×		
„ *parvispicula*,				×		×			
„ *pyriformis*,				×		×			
„ *ridleyi*,				×		×			
Stelletta phrissens,					×		×		
Tribrachium schmidtii (Weltner),		×				×			
Disyringa dissimilis (Ridley),				×		×			
Stryphnus niger,				×		×			
Psammastra murrayi,				×		×			
Amphius huxleyi,				×			×		
Erylus formosus,		×				×			
Caminus sphæroconia,		×				×			
Cydonium hirsutus,				×			×		
„ *magellani*,					×		×	×	
„ *glariosus*,		×				×			
„ *eosaster*,				×		×			
Synops neptuni,		×						×	
„ *nitida*,				×		×			
„ *vosmaeri*,		×						×	
Isops pachydermata,	×								×
Thrombus challengeri,				×			×		
Theonella swinhoei, Gray,				×		×			
Discodermia discifurca,				×		×			
„ *panoplia*,				×			×		
„ *ornata*,									
Neosiphonia superstes,				×				×	
Corallistes typus, O. Schmidt,		×						×	
„ *masoni* (Bow.),	×						×		
„ *thomasi*,				×			×		
„ *bowerbanki* (Johnson),	×								
Pleroma turbinatum,				×				×	
Callipelta ornata,				×			×		
Scleritoderma flabelliformis,				×			×		
Siphonidium capitatum,				×			×		
Azorica pfeifferæ, Carter,	×	×		×		×	×	×	×
„ *marginata*,				×			×		
„ *crassiuscula*,									
Tretolophus paniceus,				×			×		
	15	17	6	47	3	35	33	16	5

TABLE OF ALL KNOWN SPECIES OF TETRACTINELLIDA, SHOWING THEIR GEOGRAPHICAL AND BATHYMETRICAL DISTRIBUTION.

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Order CHORISTIDA.					
Suborder SIGMATOPHORA.					
Family I. Tetillidæ.					
Genus 1. *Tetilla*, O. Schmidt.					
Tetilla antarctica, . .	74° 30′ S., 175° 0′ W., .	...	206		
	77° 30′ S., . . .	...	300		
,, *arabica*, . .	South-east coast of Arabia,	...	shore.		
,, *australiensis*, . .	Port Phillip Heads, South-east Australia, .	...	20		
	Port Elizabeth, Natal, .	...	shallow (?)		
,, *casula*, . . .	52° 4′ S., 71° 22′ W., .	150	150	1°·8 C.	rock.
,, *coronida*, . .	South-east Arabia, .	...	shallow (?)		
,, *dactyloidea*, . .	Mergui Archipelago, .	...	under 50 (?)		
	Desterro, South America,	...	shallow (?)		
,, *euplocamus*, . .	Bay, Rio Janeiro, . .	...	lowest spring	...	sandy mud.
	Jan Mayen, . . .	...	191–216		
,, *geniculata*, . .	Kerguelen, . . .	...	10–100		
,, *grandis*, . . .	49° 28′ S., 70° 30′ E., .	149B	25	...	volcanic mud.
	Christmas Island, . .	...	120		
,, *grandis*, var. *alba*, .	52° 4′ S., 71° 21′ E., .	150	150	35°·2	coarse gravel.
,, *gravata*, . . .	Buzzard's Bay, Massachusetts, North America,	...	(?)		
	Japan, ...	...	(?)		
,, *japonica*, . .	37° 17′ S., 53° 52′ W., .	320	600	37°·2	green sand.
,, *leptoderma*, . .	Cape York, Torres Strait,	...	3–11	...	green sand.
,, *merguiensis*, . .	King's Island, Mergui.				
	0°48′30″S., 126°58′30″E.	196	825	36°·9	hard ground.
,, *pedifera*, . .	Iceland, ...	...	85		
,, *polyura*, . . .	77° 7′ N., 49° 37′ E., .	...	170		
	75° 20′ N., 46° 40′ E., .	...	150		
	72° 36′ N., 24° 57′ E., .	...	140		
,, *radiata*, . . .	Rio de Janeiro, South America, . . .	...	3	..	black mud.
,, *sandalina*, . .	37° 26′ N., 25° 13′ W., .	78	1000	...	volcanic mud.
,, *stipitata*, . .	Port Phillip Heads, South-east Australia, .	...	20		
,, *ridleyi*, . . .	Gloriosa Islands, . .	...	low water.		
,, *robusta*, . . .	King's Island, Mergui, .	...	on rocks.		
,, sp., . . .	34° 58′ N., 139° 29′ E., .	...	236–775	...	green mud.
Genus 2. *Chrotella*, Sollas.					
Chrotella macellata, . .	11° 37′ N., 123° 31′ E.,	208	18	...	blue mud.
,, *simplex*, . .	36° 59′ S., 150° 20′ E., .	163	150	...	green mud.
Genus 3. *Cinachyra*, Sollas.					
Cinachyra barbata, . .	49° 28′ S., 70° 30′ E., .	149B	25	...	volcanic mud.
	49° 32′ S., 70° 0′ E., . .	149C	60	...	volcanic mud.

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Genus 4. *Craniella*, O. Schmidt.					
Craniella atropurpureum, .	(?)	...	(?)		
„ *abyssorum*, . .	Between North Scotland and the Færöe Isles, .	...	632		
„ *carteri*, . .	Bahia, ...	...	shallow (?)		
„ *cranium*, . .	Island of Arran, . .	...	under 104(?)		
	Shetland Isles, . .	...	deep		
	Galway, Ireland, . .	...	under 50 (?)		
	The Minch, . . .	...	deep		
			under 105 (?)		
	Kors Fjord, Norway, .	...	180–300		
	59° 12′ N., 5° 57′ W., .	...	53		
	61° 0′ N., 4° 49′ E., .	...	200	6°·6 C.	ooze and clay.
	72° 53′ N., 21° 51′ E., .	...	223	1°·5	clay.
	72°14′8″N., 22°30′9″E.,	...	165		
	72°36′5″N., 24°57′5″E.,	...	140		
	72° 9′ N., 24° 42′ E., .	...	145		
	Between North Scotland and the Færöe Isles, .	...	632		
„ *infrequens*, . .	Between North Scotland and the Færöe Isles, .	...	632		
	72°57′14″N., 14°31′0″E.,	...	447	0°·8 C.	clay.
„ *insidiosa*, . .	Florida, . . .	...	17		
„ *lens*, . . .	Florida, ...	...	135–152		
„ *pulchra*, . .	36° 59′ S., 150° 20′ E., .	163A	150	...	green mud.
„ *schmidtii*, . .	18°30′30″N., 65°5′30″W.,	24	390	...	Pteropod ooze.
„ *simillima*, . .	Port Jackson, Sydney, .	...	35	65°	hard ground.
	Samboangan, . .	...	(?)		
	186°10′30″S., 142°18′0″E.,	...	8	...	coral mud.
	South Seas, Tongatabu, .	...	(?)		
„ *tethyoides*, . .	Florida, . . .	...	100–123		
„ *zetlandica*, . .	Shetland, . . .	...	under 120 (?)		
Genus (?).					
Fangophilina submersa, .	Caribbean Sea, . .	...	(?)		
Family II. Samidæ.					
Genus 1. *Samus*, Gray.					
Samus anonymus, . .	West Indies, . . .	...	(?)		
	Bahia, South America,	...	shallow (?)		
	Australia (excavating *Millepora alcicornis*),	...	shallow (?)		
	South Seas (excavating *Stylaster sanguinea*),	...	shallow (?)		
	Seychelles (in roots of *Euplectella cucumer*),	...	deep		
Suborder II. Astrophora.					
Demus I. Streptastrosa.					
Family I. Theneidæ.					
Genus 1. *Thenea*, Gray.					
Thenea delicata, . .	46° 16′ S., 48° 27′ E., .	147	1600	34°·2	Diatom ooze.

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Thenea fenestrata, . .	1° 47′ S., 24° 26′ W., .	106	1850	36°·6	Globigerina ooze.
	10° 9′ S., 35° 11′ W., .	123	1715	37°	
	Bequia, L. Antilles, .	...	1507 and 1591		
	24° 36′ N., 80° 5′ W., .	...	955		
„ *grayi*, . . .	34° 19′ S., 151° 31′ E., .	164c.	400	40°·0	green mud.
„ *intermedia*, . .	Mediterranean, . .	...	(?)		
„ *muricata*, . .	Kors Fjord, Norway, .	...	200–300		
	Vigten Island, Norway,	...	(?)		
	58° 23′ N., 48° 50′ W.,	...	1913		
	60° 29′ N., 8° 19′ W., .	...	375	31°·0	sandy mud.
	61° 15′ N., 6° 36′ E., .	...	650	6°·6 C.	clay.
	70° 36′ N., 32° 35′ E., .	...	127	1°·9 C.	clay.
	71° 52′ N., 19° 47′ E., to 72° 36′ N., 25° 58′ E.,	...	78–185		
	72° 53′ N., 21° 51′ E., .	...	228	1°·5 C.	clay.
	72° 57′ N., 14° 32′ E., .	...	447	0°·8 C.	clay.
	75° 12′ N., 3° 2′ E., .	...	1200	1°·6 C.	Biloculina clay.
	Jan Meyen, . . .	...	191–216		
	Anticosti and Gaspi, North America, .	...	220		
„ *schmidtii*, . .	36° 25′ N., 8° 12′ W., .	IV.	600	...	blue clay.
	18° 38′ 30″ N., 60° 5′ 30″ W., . . .	24	390	...	Pteropod ooze.
	38° 30′ N., 11° 14′ W.,	73	1000	39°·4	Pteropod ooze.
	Florida, „ . .	...	198		
„ *wrightii*, . .	42° 16′ S., 48° 27′ E., .	302	1600	35°·6	Globigerina ooze.
„ „ (?), . .	37° 29′ S., 83° 7′ W., .	297	1775	35°·5	Globigerina ooze.
„ *wyvillei*. . .	10° 14′ N., 123° 54′ W.,	209	95	71°·0	blue mud.
	Zebu, Philippine Islands,	...	(?)		
„ „ (?), . .	2° 33′ S., 144° 4′ E., .	218	1070	36°·4	blue mud.
Genus 2. *Pœcillastra*, n. gen.					
Pœcillastra amygdaloides, .	Cape St. Vincent, . .	...	292		
„ *compressa*, .	Shetland, ...	...	110		
	W. Scotland and Hebrides,	...	(?)		
	Queen Charlotte Islands, Pacific, . . .	...	(?)		
„ *crassiuscula*, .	Porto Praya, Cape Verde Islands, . . .	...	100–128		
„ *laminaris*, .	Amboina, East India Islands, . . .	...	100		
„ *scabra*, . .	Algiers, Mediterranean, .		(?)		
„ *schulzii*, . .	52° 4′ S., 71° 22′ E., .	150	150	35°·2	
„ *tenuilaminaris*,	34° 58′ N., 139° 29′ E.,	236	238	37°·6	green mud.
Genus 3. *Sphinctrella*, O. Schmidt.					
Sphinctrella annulata, .	Gulf of Manaar, . .	...	under 65		
„ *cribrifera*, .	St. Iago, Cape Verde Islands, . . .	...	100–128		
„ *gracilis*, . .	St. Iago, Cape Verde Islands, . . .	...	100–128		
„ *horrida*, . .	Florida, . . .	...	111–228		

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Sphinctrella ornata, . .	St. Iago, Cape Verde Islands, . . .	...	100–128		
Genus *Characella*, Sollas.					
Characella agassizi, . .	Grenada, . . .	...	164		
„ *aspera*, . .	9° 5′ S., 34° 50′ W., .	122	350	...	red mud.
„ *pachastrelloides*,	Cape St. Vincent, . .	...	374		
„ *stellettodes*, .	Off Misaki, Japan, .	...	(?)		
Genus 5. *Triptolemus*, n. gen.					
Triptolemus cladosus, . .	5° 49′ 15″ S., 132° 14′ 15″ E.,	192	142	...	blue mud.
„ *intextus*, . .	Cape St. Vincent, . .	...	374		
„ *parasiticus* (?),	(?)	...	(?)		
Genus 6. *Stœba*, n. gen.					
Stœba simplex, . . .	Gulf of Manaar, . .	...	under 65		
Genus 7. *Nethea*, n. gen.					
Nethea nana, . . .	Gulf of Manaar, . .	...	under 65		
Genus 8. *Placinastrella*, F. E. Schulze.					
Placinastrella copiosa, .	Naples, Mediterranean,	...	littoral		
Family II. Pachastrellidæ.					
Genus 1. *Pachastrella*, O. Schmidt.					
Pachastrella abyssi, . .	37° 25′ 30″ S., 12° 28′ 30″ W.,	135c	110	...	hard ground.
	Florida, . . .	...	228		
	Several places in Gulf of Mexico, . . .	...	(?)		
	Cape St. Vincent, . .	...	292		
„ (?) *connectens*, .	Florida, ...	...	7-5		
„ (?) *lithistina*, .	Gulf of Mexico, . .	...	(?)		
„ *monilifer*, .	Algiers, Mediterranean,		(?)		
Genus 2. *Calthropella*, Sollas.					
Calthropella (?) *exostitus*, .	Red Sea, . . .	...	(?)		
„ *geodides*, .	Cape St. Vincent, . .	...	292		
„ *simplex*, . .	St. Iago, Cape Verde Islands, . . .	...	100–128		
Genus 3. *Dercitus*, Gray.					
Dercitus bucklandi, . .	Budleigh Salterton, Torquay, Guernsey, English Channel, .	...	between tides		
	Westport Bay, North Atlantic, . . .	....	under 50 (?)		
Demus II. Euastrosa.					
Family I. Stellettidæ.					
Subfamily 1. Homasterina.					
Genus 1. *Myriastra*, Sollas.					
Myriastra clavosa, . .	10° 30′ S., 142° 18′ E., .	186	6	...	coral mud.
	11° 37′ N., 123° 31′ E., .	208	18	...	blue mud.
	Torres Strait, . .	...	7–9	...	sand and coral.

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Myriastra clavosa, . .	Arafura Sea, North-West Australia, . .	...	32–36	...	sand, mud, shells.
„ *clavosa*, var. *quadrata*, . .	6° 54′ N., 122° 18′ E., .	212	10	...	sand.
„ *crassicula*, .	Gulf of Manaar, . .	...	under 65		
„ *simplicifurca*, .	10° 30′ S., 142° 18′ E., .	186	8	...	coral mud.
„ *simplicissima*, .	Algiers, Mediterranean, .	...	(?)		
„ *subtilis*, . .	Kobè, Japan, . .	...	8–50		
„ *toxodonta*, . .	11° 6′ N., 123° 9′ E., .	203	20	...	mud.
Genus 2. *Pilochrota*, Sollas.					
Pilochrota anancora, .	Bahia, ...	...	7–20		
„ *cingalensis*, .	Galle, Ceylon, . .	...	(?)		
„ *crassispicula*, .	Bahia, ...	...	7–12		
„ *fibrosa*, . .	Florida, . . .	...	119		
„ *gigas*, . .	St. Paul's Rocks, . .	...	25 (?)		
„ *haeckeli*, . .	Samboangan, Philippine Islands, . . .	...	10		
„ *lactea*, . .	South Devon, . .	...	littoral.		
„ *lendenfeldi*, .	39° 10′ 30″ S., 146° 37′ 0″ E., . . .	162	38	...	sand and shells.
„ *moseleyi*, . .	Torres Strait, . .	...	3–11		
„ *pachydermata*, .	Tahiti, ...	...	30–70		
„ *purpurea*, var. *longancora*, .	Torres Strait, . .	...	3–11		
„ *purpurea*, .	Torres Strait, . .	...	4–9	...	sand and coral.
	Port Darwin, . .	...	7–12		
	Arafura Sea, North-West Australia, . . .	...	32–36	...	sand, mud, shells.
„ *purpurea*, var. *parvistella*, .	Providence Reef, Mascarene Group, . .	...	24.		
„ *tenuispicula*, .	Bermuda, West Indies,	...	(?)		
Genus 3. *Astrella*, Sollas.					
Astrella anceps, . . .	Algiers, Mediterranean, .	...	(?)		
„ *dorsigera*, . .	Adriatic, Mediterranean,	...	under 50 (?)		
„ *pumex*, . . .	Venetian Canal, Mediterranean, . . .	...	under 50 (?)		
„ *vosmaeri*, . .	50° 8′ S., 74° 41′ W., .	308	175	...	blue mud
Subfamily 2. Euasterina.					
Genus 1. *Anthastra*, Sollas.					
Anthastra æruginosa, . .	Port Phillip Heads, South Australia, .	...	6		
„ *communis*, . .	39° 10′ 30″ S., 146° 37′ 0″ E.	162	38	...	sand and shells.
	36° 59′ S., 150° 20′ E., .	163A	150	...	green mud.
	Port Jackson, . .	...	6–15		
„ *mammilliformis*,	Port Phillip Heads, South Australia, .	...	20		
„ *parvispicula*, .	38° 22′ 30″ S., 144° 36′ 30″ E.,	161	33	...	sand.
„ *pulchra*, . .	36° 59′ S., 150° 20′ E., .	163A	150	...	green mud.
„ *pyriformis*, .	Port Jackson, . .	...	30–35		
„ *ridleyi*, . .	Port Jackson, . .	...	30–35		

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Genus 2. *Stelletta*, O. Schmidt.					
Stelletta boglicii, . .	Adriatic, . . .	...	"considerable depths."		
„ *coactura*, . .	Off Guernsey, English Channel, . . .	...	under 50 (?)		
„ *collingsii*, . .	Guernsey (15 fathoms), Sark, Guliot Caves, Herne, Torbay, Westport Bay, County Mayo,	...	under 50 (?)		
„ *grubii*, . . .	Adriatic, Mediterranean,	...	under 50 (?)		
	Budleigh Salterton, South Devon, . .	...	littoral.		
	Holyhead, North Wales,	...	under 50		
„ *phrissens*, . .	50° 8′ 30″ S., 74° 41′ 0″ W.,	308	175	...	blue mud.
Genus 3. *Dragmastra*, Sollas.					
Dragmastra normani, .	Kors Fjord, Norway.	...	180		
Genus. 4. *Aurora*, n. gen.					
Aurora globostellata, . .	Galle, Ceylon, . .	...	(?)		
„ *reticulata*, . .	(?).				
Subfamily 3. Sanidasterina.					
Genus 1. *Ancorina*, O. Schmidt.					
Ancorina cerebrum, . .	Quarnero and I. Cherso, Adriatic, Mediterranean,	...	under 50 (?)		
„ *wageneri*, . .	Adriatic, Mediterranean,	...	under 50 (?)		
Genus 2. *Tribrachium*, Weltner.					
Tribrachium schmidtii, .	Bahia, ...	...	7–20		
	Morro Light, . .	...	250–400		
Genus 3. *Disyringa*, n. gen.					
Disyringa dissimilis, . .	9° 59′ S., 139° 42″ E., .	188	28	...	green mud.
	Torres Strait, . .	...	3–11		
	Torres Strait, . .	...	10	...	sand.
	Port Darwin, . .	...	7–12	...	sand and mud.
Genus 4. *Tethyopsis*, Stewart.					
Tethyopsis columnifera, .	Philippine Islands, .	...	(?)		
„ *radiata*, . .	North of New Zealand, .	...	45		
Genus 5. *Stryphnus*, Sollas.					
Stryphnus carbonarius, .	Gulf of Naples, Mediterranean, . . .	...	(?)		
„ *fortis*, . .	71° 55′ N., 20° 31′ E., .	...	179		
„ *mucronata*, .	Algiers, Mediterranean, .	...	(?)		
„ *niger*, . .	Port Jackson, . .	...	30–35		
„ *ponderosa*, . .	Trawling ground off Hastings, Guernsey and Devon, English Channel, . . .	...	under 50 (?)		

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Stryphnus rudis,	Kors Fjord, Norway,	...	180		
„ *unguiculatus*,	Port Elizabeth, South Africa,		shallow (?)		
Subfamily 4. Rhabdasterina.					
Genus 1. *Ecionema*, Bowerbank.					
Ecionema acervus,	Fiji,		(?)		
„ *australiensis*,	West Coast of Australia,	...	(?)		
„ *bacilliferum*, var. *robustus*,	Ports Eliot and Adelaide, Australia,	...	20		
„ *densum*,	Fiji,	...	(?)		
„ *nigrum*,	West Africa,	...	(?)		
„ *rotundum*,	Amirante Group, Indian Ocean,	...	13		
Genus 2. *Papyrula*, O. Schmidt.					
Papyrula candidata,	Algiers,	...	(?)		
„ *helleri*,	Adriatic,	...	35		
Genus 3. *Psammastra*, Sollas.					
Psammastra geodides,	Port Phillip Heads, South Australia,	...	13		
„ *murrayi*,	39° 10′ 30″ S., 146° 37′ E.,	162	38	...	sand and shells.
Genus 4. *Algol*, n. gen.					
Algol corticata,	Port Adelaide, South-east Australia,	...	20		
Family II. Epipolasidæ (Appendix).					
Genus 1. *Amphius*, n. gen.					
Amphius huxleyi,	Off Api, New Hebrides,	...	60–70		
Genus 2. *Asteropus*, n. gen.					
Asteropus (?) *annulatus*,	Gulf of Mexico,	...	(?)		
„ *simplex*,	Fremantle, S. Australia,	...	(?)		
Genus 3. *Coppatias*, n. gen.					
Coppatias carteri,	Torres Strait,	...	5–7	...	sand and shells.
„ *coriaceus*,	South Australia,	...	20		
„ *luteus*,	Port Western, South Australia,	...	20		
„ *purpureus*,	Port Western, South Australia,	...	20		
„ *stelliferus*,	South Australia,	...	laminarian zone.		
„ *tuberculatus*,	South Australia,	...	3		
Incertæ sedis—					
Stelletta pathologica,	Algiers,	...	(?)		
Myriastra (?) *tethyopsis*,	Gulf of Manaar, Ceylon,	...	under 65		
Stelletta profunditatis,	24° 33′ N., 84° 23′ W.,	...	1920		

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Ecionema pygmæorum,	St. Vincent,	...	95		
Ancorina tripodaria,	Algiers, Mediterranean,	...	(?)		
Demus 3. Sterrastrosa.					
Family 1. Geodiidæ.					
Subfamily 1. Erylina.					
Genus 1. *Erylus*, Gray.					
Erylus carteri,	Gulf of Manaar, Indian Ocean,	...	under 65		
,, *cylindrigerus*,	Mascarene Island,	...	24	...	sand, coral.
,, *discophorus*,	Adriatic, Mediterranean,	...	under 50 (?)		
	North West Spain, North Atlantic,	...	(?)		
,, *formosus*,	Bahia,	...	7–20		
,, *intermedia*,	Algiers, Mediterranean,	...	(?)		
,, *lendenfeldi*,	South Australia,	...	(?)		
,, *mammillaris*,	Quarnero,	...	under 50 (?)		
	Algiers, Mediterranean,	...	(?)		
,, *mastoideus*,	Grenada, Atlantic,	...	262		
,, *transiens*,	Barbados,	...	100		
	Gulf of Mexico,	...	(?)		
Genus 2. *Caminus*, O. Schmidt.					
Caminus sphæroconia,	Bahia,	...	shallow		
,, *vulcani*,	Adriatic, Mediterranean,	...	7		
Genus 3. *Pachymatisma*, Bowerbank.					
Pachymatisma areolata,	Red Sea,	...	(?)		
,, *johnstonia*,	Budleigh Salterton, Torquay, Plymouth, Guliot Caves, Roscoff, St. Malo, English Channel,	...	low spring tides.		
,, *normani*,	Kors Fjord, Norway,	...	180		
	Orkney Islands,	...	35		
	Wick, Scotland,	...	(?)		
	Shetland Islands,	...	(?)		
Subfamily 2. Geodina.					
Genus 1. *Geodia*, Lamarck.					
Geodia areolata,	Gulf of Manaar, Indian Ocean,	...	under 65		
,, *barretti*,	Vigten Island, Norway,	...	100		
	Kors Fjord, Norway,	...	180		
	71° 12′ N., 20° 30′ E.,	...	135		
,, *canaliculata*,	Algiers, Mediterranean,	...	(?)		
,, *carteri*,	Adelaide, S. Australia,	...	(?)		
,, *gibberosa*,	Martinique, Porto Rico, Antilles,	...	(?)		
,, *flemingii*,	Port Eliot, S. Australia,	...	(?)		
,, *megastrella*,	Cape St. Vincent,	...	374 292		

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Geodia nodastrella,	Between North of Scotland and Færöe Islands,	...	374		
	Stations 51, 57, 61–63, 65, H.M.S. "Porcupine,"	...	440, 632 / 114, 125		
	Off Cape St. Vincent,	...	317, 345		
,, *paupera*,	(?),	...	(?)		
,, *perarmata*,	Locality unknown,	...	(?)		
	Gulf of Manaar,	...	under 65		
,, *placenta*,	Adriatic, Mediterranean,	...	under 50 (?)		
,, *ramodigitata*,	Gulf of Manaar,	..	under 65		
,, *reticulata*,	Mexico,	...	(?)		
,, *thomsoni*,	Cuba,	...	270		
,, *tuberculosa*,	Mexico,	...	(?)		
,, *tumulosa*,	Honduras,	...	(?)		
	Jamaica,	...	(?)		
Genus 2. *Cydonium*, Fleming.					
Cydonium arabica,	South-east Arabia,	...	(?) shore		
,, *berryi*,	Lingin, China,	..	(?)		
,, *conchilegum*,	Adriatic,	...	under 50 (?)		
,, *cooksoni*,	Charles Island, Galapagos,	...	(?)		
,, *depressa*,	Dardanelles,	...	under 50 (?)		
,, *eosastra*,	Port Jackson, South-east Australia,	...	6–15		
,, *geodina*,	Algiers, Mediterranean,	...	(?)		
,, *gibberosa*,	West Indies,	...	(?)		
,, *gigas*,	Adriatic, Mediterranean,	...	under 50 (?)		
,, *glariosus*,	Bahia,	...	7–25		
,, *globostelliferum*,	Gulf of Manaar,	...	under 65		
	Port Darwin, North-east Australia,	...	tidal	...	sands and rocks.
,, *hirsutus*,	5°49′15″S.,132°14′15″W.,	192	140		
,, *inconspicua*,	South Seas,	...	(?)		
,, *japonica*,	Japan,	...	(?)		
,, *magellani*,	50° 8′ 30″ S., 74° 41′ W.,	308	175	...	blue mud.
	52° 45′ 30″ S., 73° 46′ W.,	311	246	...	blue mud.
,, *mulleri*,	Islands Fuhlah and Unst,	...	(?)		
	One Locality (?), North Atlantic,	...	(?)		
,, *normani*,	Vigten Island, Norway,	...	(?)		
,, *nux*,	Samoa Islands, South Pacific,	...	(?)		
,, *pergamentacea*,	Portugal,	...	(?)		
,, *pleiades*,	East Africa,	...	(?)		
,, *simplex*,	Greenland,	...	(?)		
,, *tuberosum*,	Adriatic, Mediterranean,	...	(?)		
Genus 3. *Synops*, Vosmaer.					
Synops macandrewii,	Vigten Island, Norway,	...	100		
,, *media*,	Mexico,	...	(?)		
,, *neptuni*,	9° 9′ S., 34° 53′ W.,	122B	32	...	red mud.
,, *nitida*,	Port Jackson, South-east Australia,	...	30–35		

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Synops pyriformis,	71° 12′ N., 20° 30 E.,	...	135		
„ *vosmaeri*,	9° 10′ S., 34° 49′ W.,	122c	350	...	red mud.
Genus 4. *Isops*, Sollas.					
Isops apiarium,	Florida,	...	153		
„ *contorta*,	Fiji,	...	(?)		
„ *dysoni*,	Honduras, Caribbean Sea,	...	(?)		
„ *globus*,	Portugal,	...	(?)		
„ *imperfecta*,	South Seas,	...	(?)		
„ *inequalis*,	(?),	...	(?)		
„ *pachydermata*,	32° 8′ 45″ N., 64° 59′ 35″ W.,	56	1075	38·2	coral mud.
„ *parasiticus*,	(?),	...	(?)		
„ *phlegraei*,	Kors Fjord,	...	180		
	71° 12′ N., 20° 31′ E,	...	135		
Family II. Placospongidæ. Genus 1. *Placospongia*, Gray.					
Placospongia carinata,	South Seas,	...	(?)		
	Straits of Malacca,	...	under 100 (?)		
	Torres Strait,	...	7		
„ *intermedia*,	Punta Arenas, Central America,	...			
	(?) Florida,	...	30–36		
„ *melobesioides*,	Borneo,	...	(?)		
	Gulf of Manaar,	...	under 65		
Incertæ sedis—Genus *Antares*.					
Antares euastrum,	Grenada, West Indies,	...	170		
Suborder II. Microsclerophora. Family I. Placinidæ, F. E. Schulze. Genus *Placina*, F. E. Schulze.					
Placina monolopha,	Mediterranean,	...	1–2		
„ *dilopha*,	Mediterranean,	...	littoral		
„ *trilopha*,	Mediterranean,	...	littoral		
Genus 2. *Placortis*, F. E. Schulze.					
Placortis simplex,	Mediterranean,	...	littoral		
Family II. Corticidæ, Vosmaer. Genus 1. *Corticium*, O. Schmidt.					
Corticium candelabrum,	Zebu, Adriatic,	...	under 50 (?)		
„ *versatile*,	Island of St. Vincent, West Indies,	...	95		
Genus 2. *Calcabrina*.					
Calcabrina plicata,	Mediterranean,	...	(?)		

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Genus 3. *Corticella.*					
Corticella stelligera, . .	Sebenico, Algiers, Mediterranean, . .	...	(?)		
Genus 4. *Rhachella.*					
Rhachella complicata, .	Seychelles, Indian Ocean,	...	deep water		
Family III. Thrombidæ.					
Genus 1. *Thrombus.*					
Thrombus challengeri, .	16° 45′ S., 168° 7′ W., .	177	130	...	volcanic mud.
,, *abyssi*, . .	48° 31′ N., 10° 3′ W., . English Channel.	...	500		
,, *ornatus*, . .	Seychelles Islands, .	...	deep water		
Order II. LITHISTIDA.					
Suborder I. HOPLOPHORA.					
Demus I. Triænosa.					
Family I. Tetracladidæ.					
Genus 1. *Theonella*, Gray.					
Theonella ferruginea, . .	(?), ...	...	(?)		
,, *prattii*, . .	East Indies, . . .	...	(?)		
,, *swinhoei*, . .	11° 37′ N., 123° 31′ E.,	208	18	...	blue mud.
	Formosa, . . .	...	(?)		
Genus 2. *Discodermia*, Bocage.					
Discodermia aspera, . .	Gulf of Manaar, Indian Ocean, . . .	...	under 65		
,, *calyx*, . .	Bay of Tokio, Japan, .	...	(?)		
	Bay of Sagami, Japan, .	...	30–60		
,, *discifurca*, .	Port Jackson, Australia,	...	30–35		
,, *dissoluta*, .	Barbados, . . .	...	56		
,, *japonica*, .	Bay of Sagami, Japan, .	...	30–60		
,, (?) *lævidiscus*,	Gulf of Manaar, Indian Ocean, . . .	...	under 65		
,, *ornata*, . .	(?), ...	...	(?)		
,, *panoplia*, .	5° 49′ 15″ S., 132° 14′ 15″ E., Ki Islands, . .	192	140	...	blue mud.
,, (?) *papillata*, .	Gulf of Manaar, Indian Ocean, . . .	...	65		
,, *polydiscus*, .	Coast of Portugal, . .	...	(?)		
	Near Cape St. Vincent, .	...	374		
	Island of St. Vincent, West Indies, . .	...	(?)		
,, *sinuosa*, . .	Gulf of Manaar, . .	...	under 65		
	Basse Rocks, Indian Ocean, . . .	...	(?)		
,, *vermicularis*, .	Bay of Sagami, Japan, .	...	100		
Genus 3. *Neosiphonia*, n. gen.					
Neosiphonia schmidtii, .	Gulf of Mexico, . .	...	80–92		
	Havanna, . . .	...	80–175		
	22°9′30″N., 52°21′20″W.,	...	292		
	Off Morro Light, . .	...	805		
,, *superstes*, .	19°9′35″ S., 179°41′50″ E., Fiji, . . .	173	315	...	coral mud.

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Genus 4. *Racodiscula* (Zittel).					
Racodiscula nucerium, .	Havanna, . . .	...	120–240		
„ *polydiscus*, .	Florida, . . .	...	152–183		
	Cuba, ...	...	270		
	Havanna, . . .	...	124		
„ *sceptrellifera*, .	Gulf of Manaar, . .	...	under 65		
„ *spinispirulifera*,	Gulf of Manaar, . .	...	under 65		
Genus 5. *Kaliapsis*, Bowerbank.					
Kaliapsis cidaris, . .	South Seas, . . .	...	(?)		
Genus 6. *Rimella*, O. Schmidt.					
Rimella clava, . . .	Havanna, . . .	...	292		
Genus 7. *Collinella*, O. Schmidt.					
Collinella inscripta, . .	Morro Light, Gulf of Mexico, . . .	...	292		
Genus 8. *Sulcastrella*, O. Schmidt.					
Sulcastrella clausa, . .	Sand Key, Gulf of Mexico,	...	129		
Family II. Corallistidæ. Genus 1. *Corallistes*, O. Schmidt.					
Corallistes (?) *aculeata*, .	Gulf of Manaar, Indian Ocean, . . .	...	under 65		
	Kendrick Island, Japan,	...	(?)		
„ *bowerbankii*, .	Coast of Portugal, . .	...	(?)		
	Cape St. Vincent, .	...	374		
	Madeira, . . .	...	deep water.		
„ (?) *elegantior*, .	Portugal, . . .	...	(?)		
„ (?) *elegantissima*,	Gulf of Manaar, . .	...	under 65		
„ *masoni*, . .	Madeira, . . .	...	(?)		
	Porto Praya, Cape Verde,	...	100–128		
„ *microtuberculatus*,	Cape Verde Islands, .	...	(?)		
„ *nolitangere*, .	Portugal, . . .	...	(?)		
	St. Iago, Cape Verde Islands, . . .	...	(?)		
„ *thomasi*, . .	Ki Island, south of Papua,	192	140	...	blue mud.
„ *typus*, . .	Pernambuco, 9° 5′ S., 34° 50′ W., . .	122	350	...	red mud.
	Florida, . . .	...	152–288 and $7\frac{1}{2}$		
„ (?) *verrucosa*, .	Gulf of Manaar, Indian Ocean, . . .	...	under 65		
Genus 2. *Callipelta*.					
Callipelta ornata, . .	Ki Island, south of Papua,	192	140	...	blue mud.
Genus 3. *Macandrewia*, Gray.					
Macandrewia azorica, .	St. Michael's, Azores, .	...	(?)		
	Cape St. Vincent, . .	...	374		

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Macandrewia azorica, .	Between Færöe Islands and North Coast of Scotland, . . .	...	(?)		
„ *clavatella*, .	Florida, . . .	...	152–270		
	Gulf of Mexico, . .	...	131		
Genus 4. *Dædalopelta*.					
Dædalopelta nodosa, . .	Gulf of Mexico, . .	...	(?)		
Genus 5. *Heterophymia*, Pomel.					
Heterophymia heteroformis,	Shanghai, China, . .	...	under 100 (?)		
Family III. Pleromidæ.					
Genus 1. *Pleroma*.					
Pleroma turbinatum, . .	Matuku, Fiji, 19° 9′ 35″ S., 179° 44′ 50″ E., . .	173	315	...	coral mud.
Genus 2. *Lyidium*, O. Schmidt.					
Lyidium torquila, . .	Cuba, ...	...	270		
Demus II. Rhabdosa.					
Family I. Neopeltidæ.					
Genus 1. *Neopelta*, O. Schmidt.					
Neopelta perfecta, . .	Gulf of Mexico, . .	...	(?)		
„ *imperfecta*, . .	Barbados, . . .	...	103		
Family II. Scleritodermidæ.					
Genus 1. *Scleritoderma*, O. Schmidt.					
Scleritoderma flabelliformis,	Ki Islands, . . .	192	140	...	blue mud.
„ *packardi*, .	Gulf of Mexico, . .	...	(?)		
Genus 2. *Aciculites*.					
Aciculites higginsi, . .	Havanna, . . .	...	100		
Family III. Cladopeltidæ.					
Genus 1. *Siphonidium*, O. Schmidt.					
Siphonidium capitatum, .	Ki Islands, . . .	192	140	...	blue mud.
„ *ramosum*, .	Florida, . . .	...	125		
	Sombrero, . . .	...	240		
	Morro Light, . .	...	212		
Suborder Anoplia.					
Family I. Azoricidæ.					
Genus 1. *Azorica*, Carter.					
Azorica chonellides, . .	Bay of Sagami, Japan, .	...	(?)		
„ *crassiuscula*, . .	(?), ...	...	(?)		
„ *marginata*, . .	Ki Islands, . . .	192	140	...	blue mud.
„ *pfeifferæ*, . .	Bermudas, 32° 21′ 30″ N., 64° 35′ 55″ W., .	33	435	...	coral mud.
	Bermudas, 32° 8″ 45″ N., 64° 59′ 35″ W., .	56	1075		

	Locality.	Station.	Depth in Fathoms.	Bottom Temp.	Nature of Bottom.
Azorica pfeifferæ, . .	Madeira, ...	...	(?)		
	Cape St. Vincent, Portugal,	...	374		
	Porto Praya, Cape Verde Islands, . . .	...	100–128		
	Bahia, ...	...	shallow (?)		
	Amboina, . . .	...	15–20		
Genus 2. *Tretolophus.*					
Tretolophus paniceus, . .	Off the Ki Islands, south of Papua, . . .	192	140	...	blue mud.
Genus 3. *Gastrophanella*, O. Schmidt.					
Gastrophanella implexa, .	West Indian Islands, .	...	(?)		
	25° 23′ N., 83° 31′ W., .	...	101		
	22′9″15″ N., 82° 20′30″ W.,	...	127		
Genus 4. *Setidium*, O. Schmidt.					
Setidium obtectum, . .	Havanna, . . .	...	128–240		
Genus 5. *Poritella*, O. Schmidt.					
Poritella decidua, . .	Gulf of Mexico, . .	...	100–805		
Genus 6. *Amphibleptula*, O. Schmidt.					
Amphibleptula madrepora, .	Barbados, . . .	...	100		
	Havanna, . . .	...	292		
Genus 7. *Tremaulidium*, O. Schmidt.					
Tremaulidium geminum, .	25° 53′ N., 83° 1′ W., .	...	131		
Genus 8. *Leiodermatium*, O. Schmidt.					
Leiodermatium lynceus, .	Portugal, . . .	...	(?)		
	St. Iago, Porto Praya, .	...	(?)		
Genus 9. *Sympyla.*					
Sympyla cribrifera, . .	Barbados, . . .	...	200		
Family II. Vetulinidæ. Genus 1. *Vetulina*, O. Schmidt.					
Vetulina stalactites, . .	Barbados, . . .	...	100		
	West Indies (?), . .	...	(?)		

TABLE OF ALL KNOWN GENERA OF TETRACTINELLIDA, SHOWING THEIR GEOGRAPHICAL AND BATHYMETRICAL RANGE.

	No. of Sp. / No. of Oc.	N. Atlantic.	S. Atlantic.	Indian Ocean.	E. Pacific.	W. Pacific.	Antarctic and S. Indian.	Locality (†).	0–50	51–200	201–1000	1001 and over	Depth (?).
Tetilla,	22 31	3 7	3 4	7 7	5 6		4 7		9 10	4 9	5 6		5 6
Chrotella,	2 2				1 1		1 1		1 1	1 1			
Cinachyra,	1 1						1 1		1 1				
Craniella,	12 27	8 20	1 1		2 5			1 1	2 3	4 9	4 7		3 8
Family Tetillidæ,	37 61	11 27	4 5	7 7	8 12		6 9	1 1	13 15	9 19	9 13		8 14
Samus,	1 5	1 1	1 1	1 1	1 1			1 1					1 5
Family Samidæ,	1 5	1 1	1 1	1 1	1 1			1 1					1 5
Thenea,	8 29	4 20	1 2		2 4	1 2	1 1			4 6	4 11	5 10	3 3
Pœcillastra,	7 9	4 5			2 2	1 1	1 1			3 3	3 3		1 3
Sphinctrella,	5 5	4 4		1 1						4 4			1 1
Characella,	4 4	2 2	1 1		1 1					1 1	2 2		1 1
Triptolemus,	3 3	1 1			1 1			1 1		1 1	1 1		1 1
Stoeba,	1 1			1 1						1 1			
Nethea,	1 1			1 1						1 1			
Placinastrella,	1 1	1 1							1 1				
Family Theneidæ,	30 53	16 33	2 3	3 3	6 8	2 3	2 2	1 1	1 1	15 17	10 17	5 10	7 9
Pachastrella,	4 7	4 6	1 1						1 1	1 1	1 2		2 3
Calthropella,	3 3	2 2		1 1						1 1	1 1		1 1
Dercitus,	1 4	1 4							1 4				
Family Pachastrellidæ,	8 14	7 12	1 1	1 1					2 5	2 2	2 3		3 4
Myriastra,	7 10	1 1		1 1	5 8				8	1 1			1 1
Pilochrota,	14 16	4 4	2 2	2 2	6 8				11 13	1 1			2 2
Anthastra,	7 9				7 9				6 7	2 2			
Astrella,	4 4	3 3				1 1			2 2	1 1			1 1
Stelletta,	5 11	4 10				1 1			6 10	1 1			
Dragmastra,	1 1	1 1								1 1			
Aurora,	2 2			1 1				1 1					2 2
Ancorina,	2 2	2 2							2 2				
Tribrachium,	1 2	1 1	1 1						1 1		1 1		
Disyringa,	1 4				1 4				1 4				
Tethyopsis,	2 2				1 2				1 1				1 1
Stryphnus,	7 9	5 7		1 1	1 1				2 4	2 2			3 3
Ecionema,	6 7		1 1?	1 1	4 5				2 3				4 4
Papyrula,	2 2	2 2							1 1				1 1
Psammastra,	2 2				2 2				2 2				
Algol,	1 1				1 1				1 1				
Family Stellettidæ,	64 84	23 31	4 4	6 6	28 40	2 2		1 1	38 59	9 9	1 1		15 15
Erylus,	9 12	5 8	1 1	2 2	1 1				4 4	2 2	1 1		2 5
Caminus,	2 2	1 1	1 1						2 2				
Pachymatisma,	3 11	2 10		1 1					2 7	1 1			1 3
Geodia,	16 28	10 21		3 3	2 2			1 2	1 1	5 8	3 8		9 11
Cydonium,	22 27	12 13	1 1	3 3	6	2 3	1 1		7 7	3 3	1 1		13 16
Synops,	6 6	3 3	2 2		1 1				2 2	2 2	1 1		1 1
Isops,	9 10	5 6			1		1 1	2 2		2 3		1 1	6 6
Family Geodiidæ,	67 96	38 62	5 5	9 9	10 11	2 3	2 2	3 4	18 23	15 19	6 11	1 1	32 42

	No. of Sp. / No. of Oc.	N. Atlantic.	S. Atlantic.	Indian Ocean.	E. Pacific.	W. Pacific.	Antarctic and S. Indian.	Locality.	0–50	51–200	201–1000	1001 and over	Depth (?).
Placospongia,	3 7	1 2		1 1	2 3		1 1		2 2	1 1			2 4
Family Placospongidæ,	3 7	1 2		1 1	2 3		1 1		2 2	1 1			2 4
Antares (*Incertæ sedis*),	1 1	1 1								1 1			
Amphius,	1 1				1 1					1 1			
Asteropus,	2 2	1 1			1 1								2 2
Coppatias,	6 6				6 6				6 6				
Family Epipolasidæ,	9 9	1 1			8 8				6 6	1 1			2 2
Placina,	3 3	3 3							3 3				
Placortis,	1 1	1 1							1 1				
Family Placinidæ,	4 4	4 4							4 4	1 1			
Corticium,	2 3	2 3							1 2	1 1			1 2
Calcabrina,	1 1	1 1											1 1
Cortacella,	1 2	1 2											1 2
Rhachella,	1 1			1 1						(?)			
Family Corticidæ,	5 7	4 6		1 1					1 2	1 1			3 5
Thrombus,	3 3	1 1		1 1	1 1					1 1	1 1		1 1
Family Thrombidæ,	3 3	1 1		1 1	1 1					1 1	1 1		1 1
Theonella,	3 4				2 3			1 1	1 1				3 3
Discodermia,	12 16	2 4		4 5	5 6			1 1	3 3	7 7	1 1		1 5
Neosiphonia,	2 5	1 4			1 1					1 2	2 3		
Kaliapsis,	1 1				1 1								1 1
Racodiscula,	4 6	2 4		2 2						4 5	2 2		
Rimella,	1 1	1 1									1 1		
Collinella,	1 1	1 1									1 1		
Sulcastrella,	1 1	1 1								1 1			
Family Tetracladidæ,	25 35	8 15		6 7	9 11			2 2	4 4	13 15	7 8		5 9
Corallistes,	10 16	6 10	1 1	3 3	2 2				1 1	6 6	2 2		3 8
Callipelta,	1 1				1 1					1 1			
Macandrewia,	2 5	2 5								1 2	1 2		1 2
Dædalopelta,	1 1	1 1											1 1
Heterophymia,	1 1				1 1								1 1
Family Corallistidæ,	15 24	9 16	1 1	3 3	4 4				1 1	8 9	3 4		6 12
Pleroma,	1 1				1 1						1 1		
Lyidium (?),	1 1	1 1									1 1		
Family Pleromidæ,	2 2	1 1			1 1						2 2		
Neopelta,	2 2	2 2								1 1			1 1
Family Neopeltidæ,	2 2	2 2								1 1			1 1

	No. of Sp.	No. of Oc.	N. Atlantic.	S. Atlantic.	Indian Ocean.	E. Pacific.	W. Pacific.	Antarctic and S. Indian.	Locality (?).	0–50	51–200	201–1000	1001 and over	Depth (?).
Scleritoderma,	**2**	2	**1**	1		**1**	1				**1**	1		**1** 1
Aciculites,	**1**	1	**1**	1							**1**	1		
Family Scleritodermidæ,	**3**	3	**2**	2		**1**	1				**2**	2		**1** 1
Siphonidium,	**2**	4	**1**	3		**1**	1				**2**	2	**1** 2	
Family Cladopeltidæ,	**2**	4	**1**	3		**1**	1				**2**	2	**1** 2	
Azorica,	**4**	10	**1**	5	**1** 1		**3**	3		**1** 1	**2** 2	**2** 2	**1** 3	**3** 3
Tretolophus,	**1**	1					**1**	1				**1** 1		
Gastrophanella,	**1**	3	**1**	3								**1** 2		**1** 1
Setidium,	**1**	1	**1**	1								**1** 1	**1** 1	
Poritella,	**1**	1	**1**	1								**1** 1	**1** 1	
Amphibleptula,	**1**	2	**1**	2								**1** 1	**1** 1	
Tremaulidium,	**1**	1	**1**	1								**1** 1		
Leiodermatium,	**1**	2	**1**	2										**1** 2
Sympyla,	**1**	1	**1**	1								**1** 1		
Family Azoricidæ,	**12**	22	**8**	16	**1** 1		**4**	4		**1** 1	**2** 2	**9** 10	**4** 6	**5** 6
Vetulina,	**1**	2	**1**	2								**1** 1		**1** 1
Family Anomocladidæ,	**1**	2	**1**	2								**1** 1		**1** 1
Total,	**294**	438	**140**	238	**19** 21	**39** 40	**84**	106	**6** 8	**11** 14	**10** 11	**92** 124	**92** 112	**46** 68	**6** 11	**93** 131

The thick figures in every case refer to the number of species, the thin to the number of recorded occurrences. Obviously, as the investigation of an area proceeds the number of recorded occurrences must tend to increase more rapidly than that of new species, and the ratio of species to occurrences should be less the more completely the fauna of a district is known; this will appear from the table; in the North Atlantic, for instance, the ratio of species to occurrences expressed as a percentage is 59, in the East Pacific 79·2, in the Indian Ocean 97·5; in the remaining oceans the occurrences are not numerous enough to be of any statistical value.

DISCUSSION OF THE DISTRIBUTION OF THE TETRACTINELLIDA.

The data at our disposal are as yet altogether inadequate for an independent and complete discussion of the problem of the distribution of the Tetractinellida; the number of recorded species is certainly large, but far from being large enough, and though they have been gathered from many localities, yet there are wide areas from which not a single species is known. But even were it otherwise, it would probably be scarcely prudent to undertake the investigation of the question of distributional areas on the facts presented by a single group of sponges, and that not a very large one.

At the same time I may be permitted to point out certain coincidences and to offer some suggestions.

In the first place, as a glance at the appended map will show, all the stations from which Tetractinellida have been obtained are situated, quite irrespective of depth, at no great distance from land. The course of the Challenger is indicated by a long train of dredgings, unsuccessful as regards the capture of Tetractinellids, till the approach of land, and then the red circle indicative of a successful haul at once appears. This would not be a fact of any special significance if the Tetractinellida, like the Calcarea and Ceratosa, were exclusively shallow-water forms, but it acquires great interest when we find that characteristically deep-water forms, like the species of the genus *Thenea*, are similarly confined to the vicinity of land; these species have been obtained nine times from depths between 1000 and 2000 fathoms, but in every instance they were found near the shores of some continent or island. Out of one hundred and forty-four dredgings between 1000 and 2000 fathoms, the Challenger eight times obtained species of *Thenea* near land, but not one at any great distance from it. In the case of the Hexactinellida, Schulze states that they were indeed found in the middle of the great oceans, but "generally speaking the abundance of species was least at a distance from the mainland, and in the middle of the great oceanic basins, than in the neighbourhood of the continent or island groups." The Monaxonida in the same way cling to the land, though with more frequent exceptions than in the case of the Tetractinellida; in the North Atlantic the statement is true without an exception; in the South Atlantic, with one, as at Station 332, where, remote from land, from a depth of 2200 fathoms, a single species was obtained; in the Indian Antarctic it is likewise true with a single exception, that of Station 157, which yielded one species from a depth of 1500 fathoms; the Pacific furnishes four exceptions, three stations at a considerable distance from land yielded each one species from depths of between 2000 and 3000 fathoms, these are Station 241, 246, and 248; and a fourth, Station 291, two species from a depth of 2250 fathoms. Stations 241, 246, and 248 ought perhaps not to be reckoned as exceptions, since they are within 300 miles of coral reefs, and I have regarded in the case of *Thenea*

one station, Station 106, as lying near St. Paul's Island, while it is actually over 300 miles distant from it.

If it should prove true that as a rule the deep-sea fauna is associated with adjacent land, our task in delimiting distributional marine areas will probably become simplified, and we shall have to name our provinces less from ocean basins than from adjacent coasts, giving these "maritime rights" over the adjoining ocean. A study of distributional provinces from other and independent points of view confirms this impression.

The distributional provinces which, with certain modifications, we find best suited to express the case of the Tetractinellida, are those given by Dr. Woodward in his Manual of the Mollusca, partly founded on the work of Edward Forbes. These are as follows:—(1) an *Arctic* province, which extends in the Atlantic over the coast of the British Isles (interdigitating with the *Lusitanian* area) and for an undefined distance along the eastern coast of North America; in the Pacific at least as far as Vancouver Island along the western side of the same continent, and for some distance probably along the north Asiatic coast, whence however Tetractinellida have not yet been obtained; (2) a *Lusitanian* province, which extends from the British Islands southwards as far probably as Senegambia, and which includes the Mediterranean; (3) a *Caribbean*, which includes the shores of the Caribbean Sea, the Gulf of Mexico, and extends possibly as far as Cape St. Roque on the south, and for an undefined distance past Florida on the north; (4) a *Brazilian*, which extends from Cape St. Roque along the shores of South America for an undefined distance—whether it is distinct from the Patagonian as defined by Woodward, we have no evidence from the Tetractinellida to show; (5) a *Magellanic* province, which includes both the Atlantic and Pacific shores of Patagonia; (6) an *Indian Antarctic* or *Kerguelian* province, of which Kerguelen is the centre; (7) a *South Australian* province, which includes the shores of Australia south of latitude 25°, and to which New Zealand possibly belongs; (8) an *Afric-Asian*, or *Indo-Pacific* province, which extends from Japan southwards as far as latitude 25°, *i.e.*, till it meets the South Australian province, and westwards as far as and including the Red Sea, and the eastern coast of Africa as far as the northern limit of the South African province; whether Japan should be included in this province or not I do not know, and it is possible a line of subdivision may be discovered cutting off the eastern part of the area from the western, and lying somewhere near the peninsula of India, though so far as the Tetractinellids are concerned they offer but little evidence in favour of such a supposition; in this Report therefore we shall include Japan and the Indo-African coast in the Afric-Asian area; (9) and last, a *South African* province, which has the Cape of Good Hope for its centre, but the northern limits of which are not defined either on the Atlantic side or that of the Indian Ocean.

The species inhabiting these provinces are given in the following tables:[1]—

[1] When a species is common to two or more provinces, its name is followed by one or more capital letters within brackets, to indicate the other province or provinces in which it occurs; thus in the list of Lusitanian species, *Azorica pfeifferæ* is followed by (C.B.P.), which means that it has also been found in the Caribbean, Brazilian, and Pacific areas.

SPECIES OF THE FAUNISTIC PROVINCES.

Arctic.

Tetilla geniculata, Mrz., p. 46.
„ *gravata*, Htt., p. 46.
„ *polyura*, O. Sch., p. 47.
Craniella abyssorum, Ctr., p. 50.
„ *cranium*, Mul., p. 50.
„ *infrequens*, Ctr., p. 53.
„ *zetlandica*, Ctr., p. 55.
Thenea muricata, Bwk., p. 95.
Pœcillastra compressa, Bwk., p. 98.
Stelletta grubii, O. Sch., p. 186 (L.).
Synops macandrewii, Bwk., p. 265.
„ *pyriformis*, Vosm., p. 266.
Dragmastra normani, Soll., p. 187.
Stryphnus fortis, Vosm., p. 192.
Stryphnus rudis, n. sp., p. 194.
Pachymatisma normani, n. sp., p. 243.
Geodia barretti, Bwk., p. 250.
„ „ var. *nodastrella*, Ctr., p. 247.
Cydonium mulleri, Fl., p. 254.
„ *normani*, n. sp., p. 263.
„ *simplex*, O. Sch., p. 264.
Isops phlegræi, Soll., p. 267.
Macandrewia azorica, Ctr., p. 340 (L.).
Corallistes (?) *borealis*, Ctr.

Lusitanian.

Tetilla sandalina, Soll., p. 1.
Thenea schmidtii, Soll., p. 67 (C.).
„ *intermedia*, n. sp., p. 97.
Pœcillastra amygdaloides, O. Sch.
„ *crassiuscula*, Soll., p. 83.
„ *scabra*, O. Sch., p. 99.
Sphinctrella cribrifera, Soll., p. 87.
„ *gracilis*, n. sp., p. 89.
„ *ornatus*, n. sp., p. 90.
Triptolemus intextus, n. sp., p. 102.
Placinastrella copiosa, F. E. S., p. 103.
Pachastrella abyssi, O. Sch., p. 104 (C.).
„ *monilifer*, O. Sch., p. 110.
Calthropella simplex, n. sp., p. 107.
„ *geodides*, Ctr., p. 111.
Dercitus bucklandi, Bwk., p. 108.
Myriastra simplicissima, O. Sch., p. 179.
Pilochrota lactea, Ctr., p. 181.
Astrella anceps, O. Sch., p. 181.
„ *dorsigera*, O. Sch., p. 182.
„ *pumex*, O. Sch., p. 183.
Stelletta boglicii, O. Sch., p. 184.
„ *coactura*, Bwk., p. 184.
„ *collingsii*, Bwk., p. 185.
„ *grubii*, O. Sch., p. 186 (A.).
Ancorina cerebrum, O. Sch., p. 188.
„ *wageneri*, O. Sch., p. 189.
Stryphnus carbonarius, O. Sch., p. 192.
„ *mucronatus*, O. Sch., p. 193.
„ *ponderosus*, Bwk., p. 193.
Papyrula helleri, O. Sch., p. 199.
„ *candidata*, O. Sch., p. 199.
Stellata (?) *pathologica*, O. Sch., p. 202.
Ancorina (?) *tripodaria*, O. Sch., p. 202.
Erylus discophorus, O. Sch., p. 237.
„ *mammillaris*, O. Sch., p. 238.
„ (?) *intermedia*, O. Sch., p. 241.

Caminus vulcani, O. Sch., p. 241.
Pachymatisma johnstonia, Bwk., p. 242.
Geodia barretti, var. *nodastrella* (A.).
„ *megastrella*, var. *levispina*.
„ *placenta*, O. Sch., p. 248.
„ (?) *canaliculata*, O. Sch., p. 254.
Cydonium depressum, O. Sch., p. 258.
„ *gigas*, O. Sch., p. 258.
„ *pergamentaceum*, O. Sch., p. 262.
„ *conchilegum*, O. Sch., p. 262.
„ *tuberosum*, O. Sch., p. 263.
„ *geodinum*, O. Sch., p. 265.
Placina monolopha, F. E. S., p. 278.
„ *dilopha*, F. E. S., p. 278.
„ *trilopha*, F. E. S., p. 279.
Placortis simplex, F. E. S., p. 279.
Corticium candelabrum, O. Sch., p. 280.
Calcabrina plicata, O. Sch., p. 281.
Corticella stellifera, O. Sch., p. 281.
Discodermia polydiscus, Boc., p. 330 (C.).
Corallistes masoni, Bwk., p. 303.
„ *bowerbankii*, J., p. 308.
„ *microtuberculatus*, O. Sch., p. 339.
„ *elegantior*, O. Sch., p. 338.
„ *noli-tangere*, O. Sch., p. 339 (W.).
Macandrewia azorica, Ctr., p. 340 (W.A.).
Azorica pfeifferæ, Ctr., p. 329 (C.B.P.).
Leiodermatium lynceus, O. Sch., p. 352 (L.).
Thrombus abyssi, Ctr., p. 282.

Caribbean.

Craniella schmidtii, n. sp., p. 38.
„ *insidiosa*, O. Sch., p. 54.
„ *lens*, O. Sch., p. 54.
„ *tethyoides*, O. Sch., p. 54.
Fangophilina submersa, O. Sch., p. 55.
Samus anonymus, Gray, p. 57 (P.).
Thenea schmidtii, Soll., p. 67 (L.).
„ *fenestrata*, O. Sch., p. 71.
Sphinctrella horrida, O. Sch., p. 100.
Characella agassizi, n. sp., p. 101.
Pachastrella abyssi, O. Sch., p. 104 (L.).
„ (?) *connectens*, O. Sch., p. 111.
„ (?) *lithistina*, O. Sch., p. 112.
Pilochrota fibrosa, O. Sch., p. 180.
„ *gigas*, Soll., p. 124.
„ *tenuispicula*, Soll., p. 127.
Stelletta (?) profunditatis, O. Sch., p. 203.
Ecionema (?) pygmæorum, O. Sch., p. 203.
Tribrachium schmidtii, Wltr., p. 154 (B.).
Isops pachydermata, n. sp., p. 236.
Erylus mastoideus, O. Sch., p. 240.
„ *transiens*, Wtr., p. 241.
Geodia tumulosa, Bwk., p. 249.
„ *gibberosa*, Lmk., p. 244.
„ *tuberculosa*, Bwk., p. 251.
„ *reticulata*, Bwk., p. 253.
„ (?) *thompsoni*, O. Sch., p. 254.
Synops media, Bwk., p. 266.
Isops (?) apiarium, O. Sch., p. 268.
„ *dysoni*, Bwk., p. 269.
Placospongia intermedia, n. sp., p. 293.
Antares euastrum, O. Sch., p. 274.

Corticium versatile, O. Sch., p. 280.
Discodermia dissoluta, O. Sch., p. 328.
,, *polydiscus*, O. Sch., p. 330 (L.).
Racodiscula polydiscus, O. Sch., p. 332.
Neosiphonia schmidtii, n. sp., p. 334.
Rimella clava, O. Sch., p. 335.
Collinella inscripta, O. Sch., p. 336.
Sulcastrella clausa, O. Sch., p. 337.
Macandrewia clavatella, O. Sch., p. 341.
Dædalopelta nodosa, O. Sch., p. 342.
Lyidium torquila, O. Sch., p. 344.
Corallistes typus, O. Sch., p. 301 (B.).
Neopelta perfecta, O. Sch., p. 344.
,, *imperfecta*, O. Sch., p. 345.
Scleritoderma packardi, O. Sch., p. 346.
Aciculites higginsi, O. Sch., p. 347.
Siphonidium ramosum, O. Sch., p. 348.
Gastrophanella implexa, O. Sch., p. 349.
Setidium obtectum, O. Sch., p. 350.
Poritella decidua, O. Sch., p. 351.
Sympyla cribrifera, O. Sch., p. 353.
Vetulina stalactites, O. Sch., p. 354.
Amphibleptula madrepora, O. Sch., p. 351.
Tremaulidium geminum, O. Sch., p. 352.

Brazilian.

Craniella carteri, Soll., p. 35.
Tetilla euplocamus, O. Sch., p. 45.
,, *radiata*, Selnk., p. 48.
Samus anonymus, Gray, p. 57.
Characella aspera, Soll., p. 92.
Pilochrota crassispicula, Soll., p. 128.
,, *anancora*, Soll., p. 132.
Tribrachium schmidtii, Wtr., p. 154 (C.).
Erylus formosus, Soll., p. 209.
Caminus sphæroconia, Soll., p. 214.
Cydonium glariosus, Soll., p. 223.
Synops neptuni, Soll., p. 227.
,, *vosmaeri*, Soll., p. 234.
Corallistes typus, O. Sch., p. 301 (C.).
Azorica pfeifferæ, Ctr., p. 319 (C.L.I.).

Magellanic.

Thenea wrightii, Soll., p. 63.
Astrella vosmaeri, Soll., p. 136.
Stelletta phrissens, Soll., p. 150.
Cydonium magellani, Soll., p. 221.

Patagonian.

Tetilla leptoderma, Soll., p. 3.

South African.

Tetilla casula, Ctr., p. 43.
Stryphnus unguiculus, n. sp., p. 195.
(?) *Ecionema nigrum*, n. sp., p. 198.

INDO-PACIFIC.

Tetilla arabica, Ctr., p. 42.
„ *dactyloidea*, Ctr., p. 44.
„ *japonica*, Lampe, p. 46.
„ *merguiensis*, Ctr., p. 14.
„ *pedifera*, n. sp., p. 6.
„ *ridleyi*, n. sp., p. 48.
„ *robusta*, Ctr., p. 48.
Chrotella macellata, Soll., p. 19.
Craniella simillima, Bwk., p. 30.
Samus anonymus, Gray, p. 57 (C.B.).
Thenea wyvillii, Soll., p. 74.
Pœcillastra laminaris, Soll., p. 84.
„ *tenuilaminaris*, p. 85.
Triptolemus cladosus, n. sp., p. 93.
Sphinctrella annulata, Ctr., p. 100.
Characella stellettodes, Ctr., p. 101.
Stœba simplex, Ctr., p. 102.
Nethea nana, Ctr., p. 103.
Calthropella exostitus, O. Sch., p. 111.
Myriastra clavosa, Rid., p. 116.
„ „ var. *quadrata*, Soll., p. 118.
„ *crassiuscula*, Ctr., p. 179.
„ *simplicifurca*, Soll., p. 114.
„ (?) *tethyopsis*, Ctr., p. 203.
„ *toxodonta*, Soll., p. 119.
Pilochrota cingalensis, Ctr., p. 180.
„ *haeckelii*, Soll., p. 120.
„ *moseleyi*, n. sp., p. 133.
„ *pachydermata*, n. sp., p. 128.
„ *purpurea*, Rid., p. 409.
„ „ var. *longancora*, Soll., p. 131.
Aurora globostellata, Ctr., p. 187.
Disyringa dissimilis, Rid., p. 161.
Tethyopsis columnifer, Stwt., p. 190.
Ecionema acervus, Bwk., p. 196.
„ *australiensis*, Ctr., p. 196.
„ *densum*, Bwk., p. 197.
„ *rotundum*, Rid., p. 198.
Erylus carteri, n. sp., p. 239.
„ *cylindrigerus*, Rid., p. 240.
Pachymatisma areolata, Bwk., p. 244.
Geodia areolata, Bwk., p. 246.
„ *perarmata*, Bwk., p. 245.
„ *ramodigitata*, Ctr., p. 253.
Cydonium arabica, Ctr., p. 262.
„ *berryi*, n. sp., p. 256.
„ *globostellifera*, Ctr., p. 261.
„ *hirsutus*, Soll., p. 218.
„ *japonicum*, n. sp., p. 256.
„ *nux*, Slnka., p. 260.
„ *pleiades*, n. sp., p. 257.
Isops contorta, Bwk., p. 271.
Placospongia melobesiodes, Gray, p. 271.
Thrombus challengeri, Soll., p. 275.
„ *ornatus*, n. sp., p. 283.
Rachella complicata, Ctr., p. 281.
Theonella swinhoei, Gray, p. 284.
„ *prattii*, Bwk., p. 326.
Discodermia aspera, Ctr., p. 327.
„ *calyx*, Död., p. 327.
„ *japonica*, Ctr., p. 329.
„ *lævidiscus*, p. 329.
„ (?) *papillata*, Ctr., p. 329.
„ *panoplia*, n. sp., p. 192.
„ *sinuosa*, Ctr., p. 330.
„ *vermicularis*, Död., p. 331.
Neosiphonia superstes, n. sp., p. 299.
Racodiscula (?) *sceptrellifera*, Ctr., p. 333.
„ (?) *spinispirula*, Ctr., p. 333.

Heterophymia heteroformis, Ctr., p. 343.
Corallistes (?) *elegantissima*, Ctr., p. 338.
„ (?) *aculeata*, Ctr., p. 338.
„ (?) *verrucosa*, Ctr., p. 339.
„ *thomasi*, n. sp., p. 307.
Callipelta ornata, n. sp., p. 309.
Pleroma turbinatum, n. sp., p. 312.
Scleritoderma flabelliformis, n. sp., p. 316.
Siphonidium capitatum, n. sp., p. 317.
Azorica pfeifferæ, Ctr., p. 319 (L.C.B.).
„ *chonellides*, Slnka., p. 349.
„ *marginata*, n. sp., p. 323.
Tretolophus paniceus, n. sp., p. 325.

South Australian.

Chrotella simplex, Soll., p. 17.
Craniella simillima, Bwk., p. 36.
„ *pulchra*, n. sp., p. 37.
Tetilla australiensis, Ctr., p. 43.
„ *stipitata*, Ctr., p. 49.
Thenea grayi, Soll., p. 55.
Pilochrota lendenfeldi, n. sp., p. 134.
Anthastra æruginosa, Ctr., p. 183.
„ *communis*, Soll., p. 140.
„ *mammilliformis*, Ctr., p. 183.
„ *parvispicula*, Soll., p. 145.
Anthastra pulchra, Soll., p. 138.
„ *pyriformis*, Soll., p. 146.
Anthastra ridleyi, Soll., p. 149.
Stryphnus niger, Soll., p. 171.
Tethyopsis radiata, Marshall, p. 190.
Ecionema bacilliferum, var. *robustum*, Ctr.
Psammastra murrayi, Soll., p. 175.
„ *geodides*, Ctr., p. 200.
Algol corticata, Ctr., p. 200.
Erylus lendenfeldi, n. sp., p. 239.
Geodia carteri, n. sp., p. 247.
„ *flemingii*, Bwk., p. 259.
Cydonium eosaster, Soll., p. 225.
Synops nitida, Soll., p. 231.
Discodermia discifurca, n. sp., p. 292.

Indian Antarctic, or Kerguelian.

Tetilla coronida, Soll., p. 9.
„ *grandis*, Soll., p. 10.
„ „ var. *alba*, Soll. p. 13.
Cinachyra barbata, Soll.
Thenea delicata, Soll., p. 60.
Pœcillastra schulzii, Soll., p. 79.

It may add to the usefulness of these tables if I now point out those species that appear to me to be particularly characteristic of the regions in which they occur. In the Arctic these are :—*Tetilla geniculata*, *Craniella abyssorum*, *Craniella cranium*, *Thenea muricata*, *Pœcillastra compressa*, and *Pachymatisma normani*; possibly *Dercitus bucklandi* should be transferred from the Lusitanian province to this; it may be a northern form which has extended southwards, as its absence from all regions outside the British area would seem to show; if this should prove to be the case, it would add a highly characteristic species to the Arctic province.

Of the Lusitanian province:—*Thenea schmidtii*, *Calthropella geodides*, *Ancorina cerebrum* and *Ancorina wageneri*, *Papyrula candidata*, *Caminus vulcani*, *Corticium candelabrum*, *Thrombus abyssi*, *Corallistes masoni* and *Corallistes bowerbankii*, may be regarded as characteristic.

Of the Caribbean:—*Thenea fenestrata*, numerous species of Geodiid sponges, including *Placospongia intermedia* and *Isops* (?) *apiarium*, are characteristic; *Corticium candelabrum* of the Lusitanian province is here represented by *Corticium versatile*; the species of Tetillidæ appear to be distinct, and one marked feature is the rich development of Lithistida, the species of which are distinct from those of the Lusitanian province.

Of the Brazilian:—*Craniella carteri*, *Caminus spheroconia*, *Cydonium glariosum*, *Synops neptuni*, and *Synops vosmaeri*, are all peculiar and well-defined species. The remarkable *Tribrachium schmidtii* occurs both in this area and in the Caribbean.

The four species from the Magellanic province are all peculiar and characteristic; several specimens of *Cydonium magellani* were obtained from two stations, so that it is probably a common form.

From the South African province the Challenger did not obtain any Tetractinellida, although several new and interesting forms of Monaxonida were brought to light. Two species of Choristida had been previously obtained from the Cape, however, and these are both peculiar, one—*Tetilla casula*—being a remarkable and extremely interesting form.

Of the Indo-Antarctic province all the species are distinct; they include the peculiar *Cinachyra barbata*, n. gen. et sp., and the exquisite *Thenea delicata*; of the former species about fifty specimens were obtained.

Of the Indo-Pacific province:—The genus *Myriastra* appears to be very characteristic, though it is not confined to it, one species occurring in the Lusitanian. The genera *Disyringa* and *Aurora* are confined to it. Well-marked and peculiar species are *Tetilla merguiensis*, which ranges from Torres Strait to Mergui, Burmah, *Tetilla pedifera*, *Chrotella macellata*, *Thenea wyvilli* (a very distinct form of *Thenea*, occurring in comparatively shallow water), *Myriastra clavosa*, *Aurora globostellata*, *Disyringa dissimilis*, *Tethyopsis columnifer*, the branching *Geodia ramodigitata*, and the great cup-shaped *Cydonium japonicum*, *Cydonium globostellifera* (a well-marked species which ranges from Torres Strait to Ceylon), *Placospongia melobesioides*, and *Placospongia carinata*, *Thrombus challengeri*, and numerous Lithistids.

The affinities of the fauna of this province with that of Brazil and the Caribbean are very remarkable: the genus *Placospongia* is confined to them, *Thrombus challengeri* is represented by sub-fossil spicules of a closely allied form (*Thrombus kittoni*) in Panama, *Tribrachium schmidtii* appears to represent *Disyringa dissimilis*; among the Lithistida *Neosiphonia superstes* is represented by *Neosiphonia schmidtii*, *Scleritoderma flabelliformis* by *Scleritoderma packardi*, and *Siphonidium capitatum* by *Siphonidium ramosum*.

The explanation of this is probably not to be found in any assumed recent close

geographical connection between the Atlantic and Pacific provinces, but in the similar climatal conditions of the different areas, which have ensured the survival of species once much more widely distributed; this explanation derives support from the fact that the representative species all belong to genera which are markedly peculiar in character, and extremely poor in species: the three Lithistid genera cited do not possess so far as we know any other species than those mentioned, *Placospongia* is an aberrant genus with but three known species, and *Tribrachium* and *Disyringa* are equally aberrant genera of Stellettidæ, but they are also sufficiently distinct from each other to deprive their representative character of any great value. The great cup-shaped *Synops* of the Brazilian province is represented by the cup-shaped *Cydonium* of Japan; cup-shaped Geodiids occur nowhere else.

The South Australian province is characterised by the genus *Anthastra*, which is peculiar to it, and which seems to represent the genus *Myriastra* of the Indo-Pacific province; the genus *Psammastra* with its two species, *Psammastra murrayi* and *Psammastra geodides*, is also peculiar to this region; the Theneid—*Thenea grayi*—is not a very distinct form, since it much resembles *Thenea muricata* of the Arctic province; *Chrotella simplex* is characteristic and represents *Chrotella macellata* of the Indo-Pacific province; similarly *Cydonium eosaster* represents *Cydonium globostellifera*; *Synops nitida* is a very distinct and characteristic species. One marked feature which appears to distinguish this region from the Indo-Pacific is the rarity of Lithistida: only one species—*Discodermia discifurca*—was obtained by the Challenger, and Dr. von Lendenfeld informs me that he did not succeed in obtaining a single specimen from Port Jackson. It is possible that this distinction is correlated with difference in climate, Lithistids preferring warm seas, and thriving best in water constantly over 40° in temperature.

From the foregoing account it would appear that the distributional areas which serve in the case of the Mollusca are, with certain modifications, also applicable to that of the Sponges, and furthermore, that the deep-water and shallow-water Sponges are referable to the same provinces.

The existence of these provinces is probably to be explained by the existence of ocean currents, and if we had but a complete and exact knowledge of these the mysteries of the distribution of marine forms would be, to a great extent, revealed. Where a current flows along a coast it will act as a distributing agent, and its action will be aided by surface drifts, which on the average will have very much the same direction as its own, but when it crosses an ocean almost bare of islands its power as a distributing agent is lost; it is therefore possible that the North Atlantic, though so much narrower than the Pacific, acts as a more efficient barrier to the passage of species from one side to the other owing to the comparative absence of islands, which in the Pacific are so plentiful; on the other hand where islands lie thickly scattered in the path of a current they cannot fail to serve as settling places to crowds of larval forms, and thus afford stepping stones

by which species are enabled to travel from one end of a province to the other; take as examples the East and West Indian Islands. The efficiency of the North Atlantic as a barrier between the Caribbean and Lusitanian provinces will appear from the following considerations. The average rate of the Gulf Stream across the Atlantic is certainly not over 2 miles per hour, or 48 miles per day, say for convenience 50; if the distance from Florida to the Canaries be taken as 3000 miles, it will take sixty days to accomplish the journey, and long before the expiration of that time the larvæ will have come to maturity and fallen to the bottom of a sea where conditions are not favourable for their existence; by this calculation we perceive, however, that distances of 500 miles may easily be accomplished by many larvæ, by those, that is to say, that do not accomplish their development in a shorter period than six days.

Returning to the case of the East and West Indies, one may suggest that the transport which must take place there of larval forms from island to island may be connected with the rich development of varieties in these areas, since swarms of larvæ must according to slight shiftings in direction of the variable currents be transported to numerous resting places differing more or less from each other as environments, and thus determining the survival of different varieties.

The general correspondence between ocean currents and distributional provinces will be seen by comparing the appended map with one of the oceanic circulation; the Arctic province would appear to be peopled by species borne southwards by the Arctic currents, the Lusitanian by the westerly extension of the Gulf Stream and its return branches; the interdigitation of the Arctic and Lusitanian faunas in the British area follows from the interdigitation which occurs between the two systems of currents. The Caribbean province is dependent on the Gulf Stream, but separated from the Lusitanian by the width of the Atlantic; possibly at some earlier period of the earth's history some kind of coast line connection extended from America to Europe, so that the Lusitanian province may have been peopled from the New World; this bridge has been long enough non-existent to allow of a differentiation of the Caribbean and Lusitanian faunas, which still, however, maintain a close family resemblance. On the other hand, as Professor Haddon suggests to me, there may have existed a chain of islands not more remote from each other and the coast than 500 miles, and extending from West Africa, south of the Verde Islands, to St. Paul's on the one hand, and thence along the connecting ridge to Brazil on the other. If so, the migration may have been as in so many other cases from the east; and since in Tertiary times the Indo-Pacific area was continuous with the Lusitanian (as already pointed out by Mr. Hoyle[1]), this might account for the resemblance previously remarked between the fauna of the Indo-Pacific and Brazilian provinces, as well as that said to exist between the Mollusca of Africa and Brazil. The Brazilian province owes its existence to the Brazil current, and as in the course of geological history the point of

[1] Report on the Cephalopoda, Zool. Chall. Exp., part xliv. p. 224.

bifurcation of the equatorial current has not always been situated exactly off Cape St. Roque, but sometimes to the north of it, so here we meet with a general resemblance to Caribbean fauna, and with certain remarkable forms which are common to both. The Magellanic, South African, and South Australian provinces owe their existence to the westerly cold currents of the Antarctic. The Indo-Pacific province owes its wide extension to the general easterly currents of the Indo-Pacific Ocean, which reach westwards as far as Africa, and on the north to Japan, where they furnish the Kuro Siwa, which probably peoples the greater number of the North Pacific Oceanic Islands. The Indo-Antarctic fauna is possibly the remnant of one once associated with that of an Antarctic continent, now preserved in isolation by its remoteness from all other areas.

The complete record kept by the Challenger of both successful and unsuccessful dredgings enables us to form some estimate of the relative richness in forms of the different distributional areas. In the following table the relation is given between the number of successful and unsuccessful dredgings for each of the three great oceans traversed by the Challenger :—

	Total Number of Dredgings.	Number of Successful Dredgings.	Per cent. of Successful Dredgings.
Atlantic, ...	129	14	10·9
Indo-Antarctic, . . .	28	4	14·3
Pacific, ...	120	21	17·5

In the next table the relative richness of the same areas in species is given, the same species being counted twice when it occurs in different dredgings, which is, however, very seldom :—

	Total Number of Dredgings.	Number of Species.	Per cent. of Species.
Atlantic, ...	129	15	11·63
Indo-Antarctic, ...	28	7	25
Pacific, ...	120	42	36·6

The relative richness of the three areas, as given in the last table, may be approximately represented by the following proportion :—

Atlantic : Indo-Antarctic : Pacific = 1 : 2 : 3.

It will be interesting to compare the results obtained from the Tetractinellida with those from the Monaxonida and Hexactinellida; the latter are given by Schulze, the former I have obtained by analysing the lists of Messrs. Ridley and Dendy, and the short one of additional Monaxonids given in Appendix II. of this Report.

	Atlantic.	Indo-Antarctic.	Pacific.
Hexactinellida, ...	19·1	50	47·1
Tetractinellida, ...	11·6	25	34·71
Monaxonida, ...	44·2	82·1	76·6

The poverty of the Atlantic as compared with the other two basins is shown by all three groups, but while the Pacific is richer in species than the Indo-Antarctic in the case of the Tetractinellida, the reverse is true in the case of the Hexactinellida and the Monaxonida.

In making these observations we must be careful, however, not to read into them more than the facts justify; thus the relative richness of the three areas we have been considering is not really the relative richness of these areas at all, but merely of the three portions of the track of the Challenger falling within them; the importance of this truistic remark will be seen if we consider how greatly the results we have reached would almost certainly have been modified had the Challenger passed right through the axis of the Caribbean area, and shaped its course through the West Indian Islands, or if it had avoided the East Indies or touched at only one of those islands. To show how favourable the conditions presented by the East Indian and associated islands of the Pacific are to the rich development of species, I have compared the richness of the eastern half of the Pacific with that of the western, the meridian of 170° being chosen as the line of separation between the two parts. We then have:—

	East Pacific, 79 Stations.		West Pacific, 41 Stations.	
	Per cent. of Stations.	Per cent. of Species.	Per cent. of Stations.	Per cent. of Species.
Hexactinellida, . . .	22·79	65·8	24·4	43·9
Tetractinellida, . . .	21·52	45·57	9·75	14·63
Monaxonida, . . .	24	86·1	22	48·8

It will be observed in the case of the Hexactinellida and Monaxonida that there is less difference in the percentage of stations for the two areas than in that of species.

The influence of the East Indian region on the results is best shown by determining the richness of the line of dredgings from Stations 181 to 220, which lie within it.

The results are given in tabular form for comparison :—

	Number of Species obtained from Thirty-six Stations (181–220).	Per cent. of Species.
Hexactinellida, . . .	34	94·4
Tetractinellida, . . .	22	61·1
Monaxonida, ...	40	111·1

This comparative richness of archipelagos in species is a very striking fact, and deserves further investigation ; probably it is the result of several factors, amongst which we may suggest the relatively large extent of coast line involving a relatively wide margin of littoral vegetation, and consequently abundant food-supply, multiplication of individuals, and strenuous competition. Next the currents, tidal, oceanic, and surface drifts have an influence ; the struggle of the adults with waves and currents is an important factor in bringing about modification,[1] and must make itself particularly felt in island groups where currents are numerous and powerful; currents may also exercise a distinct influence in bringing about the invasion of one locality by swarms of free-swimming larvæ set free from another. A third factor may be found in the great variety in the nature of the sea-floor, and particularly the numerous changes in depth, producing great variety of climate, both as regards temperature, pressure, and intensity of light.

We have, however, further to bear in mind that the richness of any rich area will appear unduly exaggerated in this investigation, since the Challenger dredgings were not made with that total want of intelligence which would be requisite to render them amenable to statistical treatment ; on the contrary, whenever a rich locality was discovered more than usually numerous dredgings were made, and were it not that these in the case of the Tetractinellida brought to light fresh individuals rather than species, the foregoing tables would be next to useless.

[1] A. R. Hunt, On the Influence of Wave-currents on the Fauna inhabiting Shallow Seas, *Journ. Linn. Soc. Lond.* (Zool.), vol. xviii. p. 262, 1884.

BATHYMETRICAL DISTRIBUTION.

The Tetractinellida range from 0 to 1913 fathoms, the maximum depth being that recorded by Perceval Wright for *Thenea muricata* (*Wyrille-thomsonia wallichii*, E. P. W.), from the North Atlantic. The range of the species of the Challenger collection is from 8 to 1850 fathoms.

In the following table the number of species in each of the groups of Sponges that have been described in the Challenger Reports is distributed in four columns, which are numbered I., II., III., IV., according as they were obtained from 0 to 50, 51 to 200, 201 to 1000, 1001 fathoms and upwards.

Table I.

	I. 0–50 Fathoms.	II. 51–200 Fathoms.	III. 201–1000 Fathoms.	IV. Above 1000 Fathoms.
Tetractinellida, . . .	16	23	18	8
Hexactinellida, ...	...	27	43	55
Monaxonida, ...	44	45	53	25
Ceratosa, ...	13	5	3	...
Calcarea, ...	16	16	3	...

In the next table, the number of species in the first column[1] being taken as a basis, the numbers in the succeeding columns indicate the numbers of species which should have been found supposing they were equally distributed independently of the depth :—

Table II.

	I. 0–50 Fathoms.	II. 51–200 Fathoms.	III. 201–1000 Fathoms.	IV. Above 1000 Fathoms.
Tetractinellida, ...	16	20·5	30	72
Hexactinellida, ...	...	27	39·51	94·63
Monaxonida, ...	44	56·375	82·5	198
Ceratosa, ...	13	16·6	24·37	...
Calcarea, ...	16	20·5	30	...

[1] In the case of the Hexactinellida, since there are no species in the first column, the number in the second has been taken as a base; it would have been better (for purposes of comparison) if this had been done in all cases.

By dividing the numbers in the first table by the corresponding numbers of the second, we obtain a fraction which represents the relative density of distribution of the group on the basis of unity. Thus, in the case of the Tetractinellida, the number in the first column of both tables is 16, so that the quotient to be placed in Table III. will be 1.

Table III.

	I. 0–50 Fathoms.	II. 51–200 Fathoms.	III. 201–1000 Fathoms.	IV. Above 1000 Fathoms.
Tetractinellida, ...	1	1·122	0·6	0·11
Hexactinellida, ...	...	1	1·088	0·581
Monaxonida, ...	1	0·8	0·6424	0·126
Ceratosa, ...	1	0·3	0·1231	...
Calcarea, ...	1	0·7707	0·1	...

These comparisons are rendered clearer by representing the proportion between the numbers of the columns by multiples instead of fractions of unity. Thus in the fourth column instead of 0·11 we place 1, and increase the contents of the other columns in proportion.

Table IV.

	I. 0–50 Fathoms.	II. 51–200 Fathoms.	III. 201–1000 Fathoms.	IV. Above 1000 Fathoms.
Tetractinellida, ...	9	11	5·4	1
Hexactinellida, . . .	...	1·72	1·872	1
Monaxonida, ...	7·92	6·336	5·048	1
Ceratosa, ...	8·1	2·437	1	...
Calcarea, ...	10	7·707	1	...

Somewhat is also to be learnt from the proportion of stations at which successful hauls were made. I therefore add a table in which the absolute number of successful stations is given in one line, followed by another in which the ratio of the number of successful hauls to the actual number of hauls made is given; this ratio in the fourth column being taken as unity, the ratios in the remaining columns are shown as multiples of it, as follows:—

TABLE V.

	I. 0–50 Fathoms.	II. 51–200 Fathoms.	III. 201–1000 Fathoms.	IV. Above 1000 Faths.	
Tetractinellida, . .	9	8	14	8	Actual number of successful hauls.
	5·06	3·54	4·17	1	Proportional number at different depths.
Hexactinellida, . .	...	7	22	28	Actual number of successful hauls.
	...	0·84	1·8	1	Proportional number at different depths.
Monaxonida, . .	6	16	15	15	Actual number of successful hauls.
	1·786	3·714	2·375	1	Proportional number at different depths.
Ceratosa, . .	7	3	1	...	Actual number of successful hauls.
	13·1	4·374	1	...	Proportional number at different depths.
Calcarea, . .	5	6	2	...	Actual number of successful hauls.
	4·327	4·007	1	...	Proportional number at different depths.

The foregoing results can be most plainly expressed by curves, such as are given in the table on p. 397. These have the further advantage of representing not only the bathymetrical distribution of each group, but its richness as compared with the other groups.

The curves are obtained by measuring off on the ordinate IV. a number of units equivalent to the number of species or successful stations met with within that range of depth, and then measuring off on the other ordinates lengths equal to the first multiplied by the proper numbers given in Table IV. Thus in the case of the curve of the Tetractinellida the number of species obtained between 1000 fathoms and greater depths is eight, this multiplied by the numbers 9, 11, and 5·4 gives the lengths to be measured off on the ordinates I., II., and III.

An inspection of this table shows that, relatively to the total number of hauls made, about as many species of Sponges were obtained between the depths of 51 and 200 fathoms as between 0 and 50 fathoms, but beyond the depth of 200 fathoms the number fell very rapidly, and still more rapidly beyond the depth of 1000 fathoms. As regards stations it will be observed that the maximum of successful stations lies on the ordinate II., the curve falling rapidly towards the ordinate I., and also, but not quite as rapidly, towards ordinate III., past this, however, there is a very sudden drop, the curve descending almost parallel with that of species, which is due to the fact that in deep-water stations seldom more than one species was obtained at each.

A great difference is to be observed in the behaviour of the station curve and the species curve in the case of the Monaxonida: the species curve culminates on the first ordinate, and then descends almost in a straight line to ordinate III., past which there is a rapid descent; the station curve on the other hand culminates on the ordinate II. of

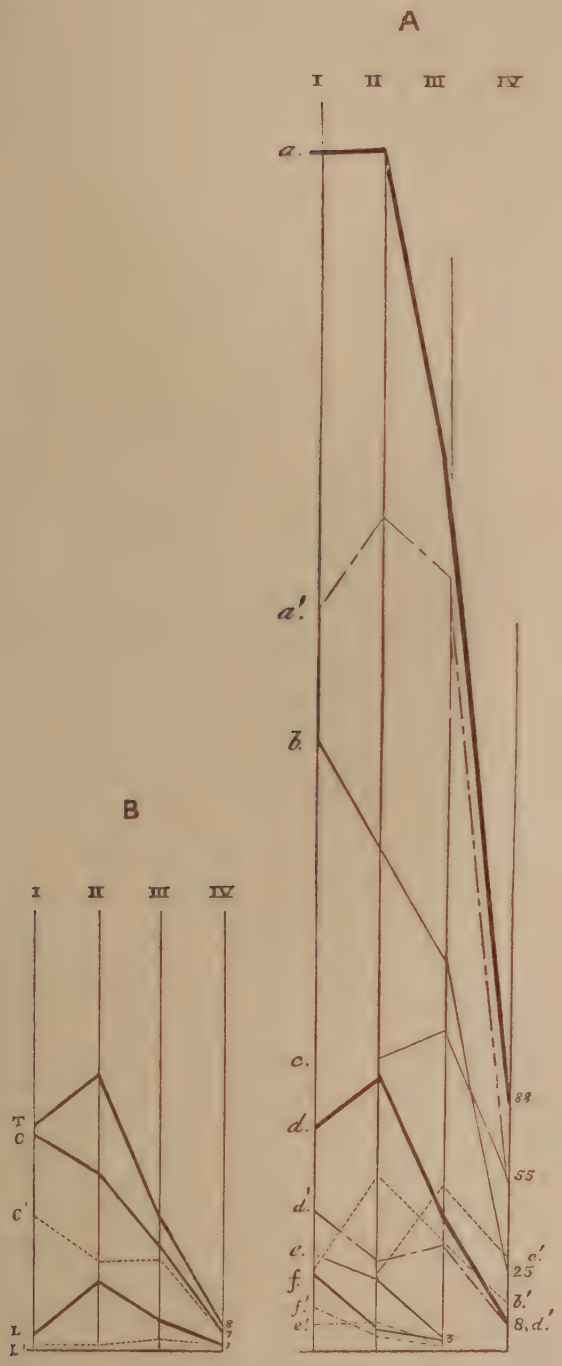


FIG. 3.—Curves illustrating the bathymetrical distribution of the Tetractinellida as deduced from the Challenger observation. A. Bathymetrical curve of the Tetractinellida compared with that of the other groups of Sponges and with that of all the groups taken together. The dotted lines indicated by letters with a dash refer to the distribution of the number of successful Stations, the continuous lines to the frequency of the occurrence of species; *a*, *a'*, curves of the Sponges taken all together; *b*, *b'*, of the Monaxonida; *c*, *c'*, of the Hexactinellida; *d*, *d'*, of the Tetractinellida; *e*, *e'*, of the Calcarea; *f*, *f'*, of the Ceratosa. B. Bathymetrical curves of the Tetractinellida and of its two orders—Choristida and Lithistida. T. Tetractinellida; C. Choristida; L. Lithistida; I., depth from 0 to 50 fathoms; II., from 51 to 200; III., from 201 to 1000; IV., from 1001 to greater depths.

continental depths, and descends a little more rapidly towards the shore than towards deep water; from this and the similar behaviour of the first curve it would appear that Sponges generally, and the Monaxonids in particular, are more generally distributed in water of from 51 to 200 fathoms deep than in depths of from 0 to 50 fathoms, but on the other hand those localities in the shallower water where they do occur are comparatively richer in species.

The curve of Hexactinellid Sponges culminates on the ordinate III., from which we may infer that the characteristic depth for this group lies between 201 and 1000 fathoms, so that this is pre-eminently the deep-water group of Sponges; it descends more rapidly towards deeper water than towards the depth of 51 to 200 fathoms, and it does not reach the first column at all; all the same Hexactinellids do extend into shallow water, since O. Schmidt records the occurrence of *Cystispongia superstes*, off Yucatan, in 18 fathoms. This will prevent our placing too much confidence on the results obtained by a single expedition; the dredgings will require to be enormously multiplied before we shall be in possession of sufficient statistics to enable us to frame completely satisfactory tables. Schulze questions the accuracy of Schmidt's record in the case of *Cystispongia superstes* just cited, because the given depth appears to be exceptional, but this is scarcely sufficient reason for setting aside Schmidt's direct statement; that the fact is exceptional gives it greater interest. On comparing the station curve with the species curve in the case of the Hexactinellida it will be observed that while both culminate on the ordinate III., the former diverges from the latter towards shallow water, but approaches it towards the abyssal depths, showing that stations are richer in species in the shallower than in the deeper water.

The Tetractinellid curve comes next in order; it culminates on the ordinate II., so that the Tetractinellida appear to flourish best in water of from 51 to 200 fathoms deep; even here where they are most numerous they fall below the Hexactinellida in numbers and far below the Monaxonida. The slope of the curve shows that they fall off much more rapidly towards the deeper than towards the shallower water. The station curve is most remote from the species curve on the ordinate II., that on which the species curve culminates, and approaches it towards the ordinates for both deeper and shallower water. Hence so far as the Challenger observations are a guide it would appear that the localities which are richest in Tetractinellid species occur in water of between 51 and 200 fathoms deep, but that on the other hand more numerous localities for Tetractinellida occur in water of from 0 to 50 and from 201 to 1000 fathoms deep. This result may not be true of Tetractinellids in all circumstances, but only of such as are obtainable by the dredge or trawl, which obviously cannot bring up to the surface species which incrust the under sides of reefs and rocks, a locality especially affected by many Sponges, including Tetractinellids.

The curves for the Ceratosa and Calcarea may be passed without comment.

It will be particularly observed that although the distribution of the Hexactinellida is characteristically deep water, and of the Monaxonida just as characteristically shallow water, yet that the Monaxonida are really commoner in deep water of from 201 to 1000 fathoms (in which depths the Hexactinellida reach their maximum) than the Hexactinellida themselves, and it is not till the depth of 1000 fathoms is passed that the Hexactinellids begin to prevail over the Monaxonids, finally, however, becoming much more numerous, in a little over the ratio of 2 : 1. It may here be added that the following proportion approximately represents the distribution of the Sponges at abyssal depths (over 1000 fathoms):—Number of Spongiæ : number of Hexactinellida : number of Monaxonida : number of Tetractinellida = 11 : 7 : 3 : 1.

It is obvious that if the bathymetrical distribution of groups of organisms remained constant throughout all time (and it is too frequently assumed that this is the case), the value of such a table of curves as that given on p. 397 as a means for determining the depth at which strata containing sponge remains had been deposited would be very great. Zittel evidently assumes that the depth at which ancient sediments were deposited may be inferred from the nature of the associated fossil Sponges, and even Schulze, speculating on the sudden appearance of the Lithistida and Hexactinellida, argues that as:—"Both groups are especially inhabitants of the deep sea [so] only in the former deep-sea deposits can one hope to find their fossil remains in any abundance." When Vosmaer, however, supposes that the ancestral forms of Sponges originated in deep water he evidently assumes a change in bathymetrical distribution but in the contrary direction to that in which it has taken place.

The question is evidently important enough to demand a few words of inquiry, and as the Hexactinellida are pre-eminently a deep-water group at present, they will best serve for investigation. The oldest known Hexactinellid is the Lyssacine *Protospongia*, which occurs in Cambrian slates, and though we have no evidence as to the depth at which the mud, out of which the slate originated, was deposited, one would probably not regard it as very great; but leaving an instance so doubtful, we pass on to the Silurian, and there encounter a remarkable group of Hexactinellids, known as the Dictyospongidæ; the individuals of this group are not, for fossil Hexactinellids, rare; many of them are of large size, and evidently lived under favourable conditions; the group ranges from the Silurian into the Carboniferous system, and is usually associated with sandstones or sandy shales. The beautiful examples from the Chemung sandstone of Devonian age occurring in North America attain a height of nearly a foot and a diameter of 5 or 6 inches. Here then we have an instance of an abundant group of Hexactinellids (Lyssacina according to James Hall) associated with rocks which were undeniably deposited in shallow water at no great distance from land, and such a plain instance to my mind altogether upsets the hypothesis that the existing bathymetrical distribution of this group is the same or even in a general way similar to that which it possessed in the past.

To take another instance, this time from the Mesozoic rocks. The Inferior Oolite of the south of England is admittedly a shallow-water deposit. Species of *Littorina* occur in it; Oysters, Pectens, and Astartes are common, and if we are logically precluded from adverting to palæontological evidence in conducting this argument, then we may refer to the false bedding, sudden variations in the nature of the deposits, and the "thick beds of sand which are locally interposed at various horizons." Mr. Whidborne,[1] from whom I quote the last sentence, considers that "the Inferior Oolite deposits were formed at an irregularly varying level, but in shallow water." Yet from this deposit at Burton Bradstock four species of Hexactinellida belonging to four genera were obtained by Mr. Whidborne, together with one species of Lithistid and one of a calcareous sponge. The single Lithistid (*Platychonia*, a genus much resembling *Azorica*) might very well occur without indicating any change in the existing bathymetrical distribution of the Lithistida, but the four species of Hexactinellids can scarcely be regarded as stragglers out of deep water.

In the Chalk the great development of Hexactinellids has been supposed to be an argument in favour of its deposition at great depths. To my mind it has always seemed that the apparently deep-sea character of the chalk was rather an argument in favour of the deep-sea character of the Sponges, but as there is no real necessity for supposing the chalk to have been anything more than a clear-sea deposit, this argument is not by itself of much value. A clear continental sea would be produced by a comparatively inconsiderable depression of the greater part of Europe and Asia, and the mountains which would still remain above the sea level would have only a very local effect in rendering it turbid; in such a sea Globigerina ooze might readily be produced, and the Cretaceous fauna with it. This is only a supposition, but that view which regards the chalk as a deep-sea deposit is nothing more.

That the bathymetrical distribution of the Hexactinellids has not always been the same as at present is I think evident, and we have no reason to suppose that that of other groups has been more constant.

On the other hand, I cannot find any suggestion of evidence in favour of Vosmaer's hypothesis that the ancestral sponges were deep-water forms; whatever evidence we have points distinctly in the opposite direction, and to this we should be led by *à priori* considerations; for the fertile source of marine forms of life is to be found in the littoral zone of algal vegetation, and it is probably here, where food and light and oxygen are most abundant, that most of the great groups of marine animals had their birth-place, but it is here also that competition is most severe, and to forms that cannot maintain their hold upon this marine Canaan, the deep-sea offers a convenient refuge.[2] If this be

[1] *Quart. Journ. Geol. Soc. Lond.*, vol. xxxix. p. 487, 1883.

[2] This opinion has been expressed by Professor Moseley, who says:—"With regard to the origin of the deep-sea fauna, there can be little doubt that it has been derived almost entirely from the littoral fauna."—Presidential address to Section D, British Association Report, 1884, p. 752.

true then we must expect a change in the bathymetrical distribution of deep-sea forms as they are traced backwards in time; a change which may be represented by a curve, with the depth for its ordinate and time for the abscissa, and traceable to an origin in the littoral zone.

The geologist then must not expect the zoologist to furnish him with tables for determining the probable depths at which ancient sediments have been deposited; these he must discover from other data, which are not wanting, and may then be able to furnish the zoologist with data for the construction of a bathymetrical curve changing with the time.

Another fallacy common among geologists is to suppose that a comparative abundance of Hexactinellids and Tetractinellids compared with Monaxonids in any deposit is an indication of great depth; this supposition is confuted even by the facts of existing bathymetrical distribution, which show that at all depths above 1000 fathoms the Monaxonids are the ascendant group; the comparative rarity of this last group of Sponges in stratified deposits is to be explained on quite other grounds—(1) By the fact that they, like the Choristida, are not furnished with a coherent skeleton, so that all that remains after their decay is loose and scattered spicules, which, being in the majority of cases of small size, are readily dissolved, and thus totally disappear, while when they are comparatively large they are liable to become mixed with precisely similar spicules of the Choristida, and thus cannot be separately identified. Another explanation, applicable however to only a few cases, is the erroneous identification occasionally made of some fossil Monaxonids with Calcareous sponges.

The absence of Lyssacine Hexactinellids is to be explained in the same way as the absence of Monaxonid spicules.

Schulze, after stating that the Hexactinellida of abyssal depths are almost exclusively Lyssacina, adds :—"The conclusion therefore seems warranted that in ancient times also the Lyssacina predominantly occurred in the greater depths, while the more differentiated Dictyonina inhabited as they now do relatively shallower water at no great distance from the coasts. Now if one may assume that the deepest regions of the great oceans have remained permanently covered by water since the Palæozoic period, while the shallower regions near the continents were here and there raised above water, we can understand why we find in certain Jurassic and Cretaceous deposits so many and highly differentiated Dictyonina, but very slight hints of Lyssacina, even under circumstances that would not preclude their preservation, or at least that of their characteristic spicules."[1]

This hypothesis it appears to me cannot be sustained in face of the fact that Monaxonids are as conspicuously absent as Lyssacina from Jurassic deposits, while if Schulze's view that the existing is a fair representation of the ancient distribution be true, then Monaxonids ought to be abundantly associated with the fossil Lithistids and

[1] Report on the Hexactinellida, Zool. Chall. Exp., part liii. p. 496.

Hexactinellids; that they are not so proves simply that the conditions for their preservation were not so favourable as Schulze seems to assume; both Lyssacina and Monaxonida are absent because they do not possess consistent skeletons.

It is quite possible also that Monaxonida and Lyssacina are less uncommon than supposed in Jurassic rocks, the difficulty may be to find them; like the skeletons of the Lithistida and Dictyonine Hexactinellids their spicules would probably be converted into carbonate of lime; and while whole skeletons like those of the Lithistida and Dictyonina may be extracted from the limestone in which they are preserved, single spicules can be so obtained only very exceptionally.

The relation between the nature of the sea-floor passed over by the Challenger and the number of species dredged is shown by the following list:—

From—

13	Stations on	hard ground	3	species were obtained, or	23	per cent.
9	„	gravel	3	„ „	33·3	„
8	„	sand	5	„ „	62·5	„
4	„	mud	0	„ „		
20	„	coral mud	7	„ „	35	„
21	„	green sand and mud	8	„ „	38·1	„
30	„	volcanic mud	6	„ „	20	„
48	„	blue mud and clay	20	„ „	41·6	„
55	„	Globigerina ooze	3	„ „	5·46	„
10	„	Pteropod ooze	3	„ „	30	„
4	„	Diatom ooze	1	„ „	25	„
4	„	Radiolarian ooze	0	„ „		
50	„	red clay	4	„ „	8	„

Thus mud and Radiolarian ooze yielded no Tetractinellida; the other deposits may be represented according to their richness (inversely, commencing with the poorest) in the following order:—

Globigerina ooze,	2	Gravel,	12
Red clay,	3	Coral mud,	13
Volcanic mud,	7	Green sand,	14
Hard ground,	8	Blue mud,	15
Diatom ooze,	9	Sand,	23
Pteropod ooze,	11		

The numbers attached to each deposit are the nearest whole numbers to multiples of 2, which is taken to represent the richness of Globigerina ooze.

If instead of species the same comparison is made for stations, we obtain the following results:—

Successful hauls were made from—

3	out of	55	Stations on	Globigerina ooze	or	5·46 per cent.
3	„	50	„	red clay	„	6 „
1	„	9	„	gravel	„	11·1 „
7	„	48	„	blue mud	„	14·58 „
5	„	30	„	volcanic mud	„	16·6 „
4	„	21	„	green sand and mud	„	19 „
2	„	10	„	Pteropod ooze	„	20 „
4	„	20	„	coral mud	„	20 „
3	„	13	„	hard ground	„	23 „
1	„	4	„	Diatom ooze	„	25 „
3	„	8	„	sand	„	37·5 „

The poverty of the Globigerina ooze is very remarkable, but no doubt it stands in relation to the fact that the Tetractinellida are comparatively rare in deep water, such as that in which the Globigerina ooze usually occurs; but one would scarcely have expected the ooze to prove poorer than the red clay. Conversely the comparative richness of coral mud, sand, and hard ground is connected with the greater abundance of Tetractinellids in shallow water. The comparative richness of Diatom ooze on the other hand is probably due to the fact that the Tetractinellida and probably other Sponges also find in the Diatoms an abundant source of food supply.

The comparative richness of the Indo-Antarctic region is probably connected with the unusually numerous dredgings made off Kerguelen, and partly with the fact that it lies within the zone of the Antarctic Diatom ooze; it is true that the bottom from whence the Tetractinellids were obtained is recorded as volcanic mud, and coarse gravel, but this is in shallow water; in the deeper water on each side of the area from which the Sponges were obtained the Diatom ooze occurs, and it would appear very probable that it is also present in the shallower deposits, but masked by the abundance of volcanic material; this is just one of those cases on which the analysis of the deposit as made by Dr. Murray is likely to throw light; but the view I have expressed is confirmed by the fact that Diatoms abound in the vestibules and cloacas of the specimens of *Cinachyra barbata*, a species rich in individuals which inhabit the volcanic mud off Kerguelen.

It now only remains to add a short summary of the distributional characters of the subdivisions of the Tetractinellida. The Choristida are cosmopolitan, with a wide bathymetrical range, extending from the coast-line to a depth of 2000 fathoms. Judged from the results of the Challenger Expedition, the zones from 0 to 50 and from 51 to 200 fathoms are equally rich in species; judged from the entire body of recorded observations (tabulated on p. 378) the former is the richer in the ratio of 100 : 68. Since the littoral zone is more accessible to general observation this gives too high a value for the littoral zone, while that deduced from the Challenger is for obvious reasons too low.

Beyond 200 fathoms the number of species rapidly falls off, as shown both by the Challenger results and those of other expeditions; from the sum total of observations we obtain the following proportion:—Number of species obtained from 0 to 50 : that from 201 to 1000 : that from 1001 and over = 100 : 35 : 7·4.

Certain families enjoy a wide bathymetrical range, as for instance the Tetillidæ, which extend from 0 to 1000 fathoms, as many species being recorded from 0 to 50 as from 50 to 1000 fathoms.

Others are more restricted, either affecting deeper water, as the Theneidæ, or shallower, as the Stellettidæ. The former family, with the exception of a single genus, doubtfully assigned to it (*Placortis*), is confined to continental or abyssal depths, an equal number ranging from 51 to 200 fathoms and from 201 to 1000. The genus *Thenea* is the characteristically deep-water genus of the Tetractinellida, the shallowest water from which it has yet been recorded being 78 fathoms, the deepest 1913 fathoms. The Stellettidæ are usually found in water under 50 fathoms deep, the greatest depth attained (250 to 400 fathoms) is that recorded by Weltner for the curiously specialised *Tribrachium schmidtii*, which would thus seem to possess a wide range, since it was obtained by the Challenger in from 7 to 20 fathoms off Bahia.

The Geodidæ, with a wider range than the Stellettidæ, are also commoner in deeper water (compare table on p. 378).

The Lithistida are more limited in range than the Choristida, seldom occurring either in such shallow or such deep water as the latter, the minimum recorded depth is $7\frac{1}{2}$ fathoms (*Corallistes typus*, *fide* O. Schmidt), the maximum 1075 fathoms (*Azorica pfeifferæ*, Challenger), the greatest number of occurrences are recorded from continental depths. Since the bathymetrical distribution of the Lithistida is regarded as of some importance by the palæontologist I add a more exact discussion of this subject. In the following table are given the various depths from which Lithistids have been obtained, with the number of times from each:—

0–50 Fathoms.	51–100 Fathoms.	101–150 Fathoms.	151–250 Fathoms.	251–350 Fathoms.	351–450 Fathoms.	451–1075 Fathoms.
1 at $7\frac{1}{2}$	1 at 56	1 at 101	1 at 168	1 at 270	4 at 374	1 at 805
1 „ 17	9 „ 65	1 „ 103	1 „ 180	3 „ 292	1 „ 435	1 „ 1075
1 „ 18	1 „ 86	2 „ 114	1 „ 211	2 „ 315		
1 „ 33	2 „ 100	1 „ 124	1 „ 212	1 „ 350		
2 „ 45		1 „ 125	1 „ 220			
		1 „ 127	1 „ 240			
		1 „ 128				
		1 „ 129				
		1 „ 131				
		1 „ 135				
		7 „ 140				
6 „ 27	13 „ 71	18 „ 126	6 „ 205	7 „ 303	5 „ 386	2 „ 940

In addition to the occurrences tabulated, there are no less than twenty-seven of which the depth is not known, and most of these are in all likelihood from comparatively shallow water, but with these omitted, the number of comparatively shallow-water forms is considerable, as many as six being recorded from depths of $7\frac{1}{2}$ to 45 fathoms; the number from 51 to 100 is abnormally increased by the large number of species, nine from 65 fathoms, described by Carter from "melobesian" nodules, similarly the number from 101 to 150 fathoms is unduly increased by the seven species (also found on calcareous nodules) at 140 fathoms from the Island of Ki; if the number of Carter's species be reduced to two, we shall have only six species occurring at an average depth of 79 fathoms in the second column, and the distribution from 0 to 100 fathoms might be regarded as fairly uniform; if, however, we reduce the number of species from Ki to three there will still remain fourteen from an average depth of 125 fathoms in the third column, and from this it would appear that the most favourable depth for Lithistid species extends from 100 to 150 fathoms; attaining their maximum development at this depth they thin away on either hand, but more rapidly towards the deeper than the shallower water; this may best be exhibited by dividing the number of species in each column by the number of fathoms giving the range; using the amended numbers obtained for columns 2 and 3, and disregarding the stragglers beyond 450 fathoms, we have the following proportion:—Number of species per fathom occurring between 0 and 50 fathoms : that from 51 to 100 : that from 101 to 150 : that from 151 to 250 : that from 251 to 350 : that from 351 to 450 = 12 : 12 : 28 : 6 : 7 : 5, and again:—Number of species per fathom from 0 to 100 fathoms : that from 101 to 150 : that from 151 to 450 = 4 : 7 : 2.

The bathymetrical distribution of the group as deduced from the Challenger results solely is expressed by curves on p. 397 (Fig. 3).

There is very little to remark with regard to the distribution of the families as distinct from the order; the wide range of the cosmopolitan species, *Azorica pfeifferæ*, may be noticed,—it extends from between 15 and 25 fathoms to 1075 fathoms; the interesting genus *Neosiphonia*, which represents the ancient *Siphonia* of the Mesozoic rocks, has also a wide range, extending from 80 to 805 fathoms.

There does not appear to be any correlation between the form or structure of the different species of Tetractinellida and the depth at which they occur, symmetrical forms do certainly occur among deep-water genera, *e.g.*, in *Thenea;* but they are also found in shallow-water genera as well, *e.g.*, in *Dysyringa;* on the other hand a correlation between structure and the nature of the sea-floor is not unusual (*vide* Introduction).

APPENDIX I.

OMISSA.

Thenea muricata (Bowerbank) (p. 95).

Tisiphonia agariciformis, Schulze, Report on the Sponges dredged by the "Knight Errant," Proc. Roy. Soc. Edin., p. 708, 1882.

Schulze records this species from Station 92, "Knight Errant," depth, 275 fathoms.

Thenea intermedia (p. 97).

Tisiphonia agariciformis, C. Keller, Archiv f. mikrosk. Anat., vol. xviii. p. 271, 1880.

Keller mentions the occurrence of this species in the Gulf of Naples, on muddy ground.

Characella pachastrelloides (Carter) (omitted from p. 101).

Stelletta pachastrelloides, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xviii. p. 403, pl. xv. fig. 40.

Sponge.—Massive, free or attached, surface asperous owing to the projection of oxeate spicules; oscules single or in groups, irregularly distributed; pores "tympanising the interstices between the projecting spicules."

Spicules.—I. Megascleres. 1. *Oxea*, 3·66 by 0·1 to 4·62 by 0·084 mm. 2. *Orthotriæne*, rhabdome 0·85 by 0·07 mm., cladi 0·49 mm. long. 3. *Anatriæne*, rhabdome 3·66 by 0·021 to 6·64 mm. long, cladi 0·17 by 0·021 mm.

II. Microscleres. 4. *Microxea*, 0·245 by 0·0064 mm. 5. *Microxea*, centrotylote or not, curved or suddenly bent in the middle, 0·0465 by 0·0085 mm. 6. *Oxyaster*, actines from six to seven in number, minutely spined towards the ends, 0·017 mm. in diameter. 7. *Amphiaster*, passing into a spiraster, 0·013 mm. in length.

Colour.—Cream-yellow.

Habitat.—Atlantic Ocean, near Cape St. Vincent; depth, 374 fathoms (Station 25, "Porcupine" expedition, 1870).

Remarks.—The general character of the skeleton is that of a *Characella;* from the other species of this genus it differs in possessing anatriænes and oxyasters. Before examining types in the British Museum, I regarded this sponge as a *Stryphnus*, with which it has many points in common, and it is possible that further examination may lead to its being placed in that genus.

Pilochrota purpurea (Ridley) (omitted from p. 180).

Stelletta purpurea, Ridley, Voyage of the "Alert," p. 473, pl. xl. fig. E; pl. xliii. figs. j. j., 1885.
Stelletta purpurea, var. *retroflexa*, Ridley, *loc. cit.*, pl. xliii. fig. k.

Sponge.—Free, subspherical, or subovate. Oscule single, circular, about 2 mm. in diameter, leading into a deep cloaca. Surface embossed with small semiglobular elevations. Cortex 0·7 mm. in thickness.

Spicules.—I. Megascleres. 1. *Oxea*, slender, sharply pointed, 1·5 to 2 by 0·037 mm. 2. *Orthotriæne*, rhabdome stout, oxeate, 1·4 to 1·6 by 0·045 to 0·06 mm.; cladi 0·27 mm. long. 3. *Anatriæne*, rhabdome slender, sharply pointed, cladome almost flat in front; rhabdome 2 by 0·035 mm. cladi 0·07 mm., chord 0·1 mm. long.

II. Microscleres. 4. *Chiaster*, actines slender, seven to ten in number, terminally tylote, centrum absent, diameter 0·02 to 0·025 mm.

Colour.—Purple. Size, about 34 by 26 mm.

Habitat.—Prince of Wales Channel, Thursday Island, and West Island, Torres Strait; depth, 4 to 9 fathoms; bottom, sand, or sand and coral.

Port Darwin; depth, 7 to 12 fathoms; bottom, sand and mud.

Arafura Sea, off north-west coast of Australia; depth, 32 to 36 fathoms; bottom, sand, mud, and shells.

Pilochrota purpurea, var. *parvistella* (Ridley).

Stelletta purpurea, var. *parvispicula*, Ridley, Voyage of the "Alert," p. 627, 1885.

Sponge.—Oval, oscule not evident.

Spicules.—I. Megascleres. 1. *Oxea*, 0·025 mm. in diameter. 2. *Orthotriæne*, rhabdome 0·032 mm. in diameter. 3. *Anatriæne*, rhabdome 0·023 mm. in diameter. All the megascleres are slenderer than those of the typical species.

II. Microsclere. 4. *Chiaster*, actines more numerous than in the typical species, diameter less, 0·007 to 0·0095 mm.

Colour.—Purple. Size, 7·5 mm.

Habitat.—Providence Reef, Mascarene Group, Indian Ocean; depth, 24 fathoms.

INCERTÆ SEDIS.

Corallistes (*?*) *borealis*, Carter.

Corallistes borealis, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. pp. 439, 442, 443, 1873.

Sponge (?).—(Overgrown by other sponges.)

Spicules.—Desmas like those of *Azorica pfeifferæ*. Dichotriænes and discotriænes are said to occur in the midst of the skeleton.

Habitat.—Færöe Islands.

Remarks.—The presence of dichotriænes and discotriænes in the interior of the desmose skeleton is so unique that one is led to suspect some source of error; discotriænes are essentially ectosomal spicules, and when they are found in the middle of a sponge, they may be looked upon as foreign inclusions.

Arabescula parasitica, Carter.

Arabescula parasitica, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 464, pl. xvii. figs. 7–9, 1873.
„ „ Zittel, Abhandl. d. k. baier. Akad. d. Wiss., Bd. i. pp. 103, 120, pl. i. fig. 11, 1878.
Corallistes parasitica, Ridley, Ann. and Mag. Nat. Hist., ser. 5, vol. xiv. p. 183, 1884.

Sponge.—Thin, incrusting.

Spicules.—Megasclere. *Desma*, epirabd, curved, branched, breaking up into filagree, depressed in a plane parallel to the surface, smooth externally, with cylindrical tubercles on the inner face.

Habitat.—West of the English Channel, growing over *Aphrocallistes bocagei*.
Seychelles, growing over *Farrea occa*.

Remarks.—In the specimen which Mr. Carter kindly presented to me, the desmas are to be seen as a single layer closely incrusting part of the deciduous skeleton of *Aphrocallistes bocagei*, they much resemble the ectosomal desmas of *Siphonidium*, but probably owe their form to their mode of growth and position, for in the case of attached Lithistids the desmas immediately in contact with the surface of attachment are frequently flattened in conformity with it, and then in some cases much resemble the desmas of *Arabescula*. As none but the incrusting desmas have been observed in this sponge, and nothing is known as to the presence or absence of microscleres, its position is eminently doubtful. I do not think it is referable to *Corallistes* as Ridley conceives, but more probably to some genus of the Azoricidæ, of which possibly it represents only the layer of desmas serving for attachment.

Collectella avita, O. Schmidt.

Collectella avita, O. Schmidt, Spong. Meerb. Mexico, p. 86, pl. v. fig. 1, 1880.

Sponge.—Knob-like, with a somewhat flattened summit, on which vertical canals open.

Spicules.—I. Megascleres. 1. *Desmæ*, tetracladose, epactines highly tuberculated, tubercles extending up to the origin of the epactines. 2. *Calthrops*. 3. *Dichotriænæ*.

II. Microscleres (?).

Habitat.—West Indian Islands, lat. 25° 33′ N., long. 84° 21′ W.

Remarks.—O. Schmidt regards this sponge as presenting an instance of a passage between the Lithistida and the Choristida, the calthrops resembling that of *Pachastrella*; this spicule according to Schmidt is not present as a foreign inclusion, but is proper to the sponge, through all parts of which it occurs equally distributed.

It is to be inferred from the description, however, that the specimen is merely a skeleton without soft parts, and while it is probable that the calthrops have not been washed in, it is by no means so certain that they have not been introduced by some excavating Pachastrellid sponge. Unfortunately I can add nothing in the way of direct observation on this point, for the specimen seems to be lost; Mr. Fewkes informs me that none bearing its name is to be found in the collection returned by Schmidt to Agassiz.

Geodia (*?*) *stellosa*, Czerniavsky (omitted from p. 274).

Geodia stellosa, Czerniavsky, Bull. Soc. Nat. Moscou, liv. p. 281, pl. iv. figs. 1–20, 1880.
Isops (*?*) *stellosa*, Vosmaer, Nied. Arch. f. Zool., Suppl.-Bd. i., 1882.

Vosmaer compares this sponge with *Isops pallida*, Vosmaer. I have not been able to refer to the account of it given by its describer, nor to the definition of the new genus *Stellogeodia* by the same author.

APPENDIX II.

MONAXONIDA.

The description of most of the Monaxonid sponges, including the Tethyidæ, which form the subject of this Appendix, was at first undertaken by my colleague, Mr. Ridley, who on finding a difficulty in assigning a position to them amongst the Monaxonida, requested me to include them in my Report of the Tetractinellida, with which group he conjectured they might naturally be associated; at first I could not assent to this view, but subsequently I agreed to treat the subject in an Appendix; still later, when Mr. Dendy joined Mr. Ridley in the Report on the Monaxonida, I returned the *Tethyæ* and some other Monaxonid sponges to them, as I could find no place for them amongst the Tetractinellida. On further consideration it seemed to me probable that the genus *Tethya* might stand in the same relation to the Stellettidæ that *Placospongia* does to the Geodiidæ, and I therefore requested my colleagues to return these sponges to me, and as they were still of the opinion that their place was not with the Monaxonids, they with the kind permission of Mr. Murray graciously acceded to my request. On examination of the minute structure of *Tethya*, the genus of which the position was most doubtful, I found that although possessing a well-developed cortex and sarcenchymatous mesoderm, the choanocytes do not present that concrescence of the collars which is so characteristic of all Tetractinellid sponges, in which the other two characters are present. I therefore was unable to include the genus with the Tetractinellida, and should have once more returned these exceptional Monaxonid sponges but for the fact that I had nearly completed their description, and time was pressing.

The characters which led Vosmaer and Ridley to suppose that *Tethya* and its allies are closely related to the Tetractinellida, appear to be the radiate arrangement of the megascleres, the character of the cortex, and the presence of spherasters. The first character does not appear to me to possess that value which Vosmaer has assigned to it. I have already shown that it is not constant in the Tetractinellida, and Ridley and Dendy show that it may be present (*Phelloderma*) in the Desmacidonidæ, which are included in Vosmaer's order Halichondridæ, and are otherwise reticulate sponges. The

value of the cortex for purposes of classification is very trifling, in the same family some sponges may possess it and others not. The spheraster seem at first sight more suggestive of a Tetractinellid origin, but very slight inquiry is necessary to show that these spicules are not specially characteristic of the Tetractinellida, indeed on the whole they would appear to be more widely distributed among the Monaxonids. The only Tetractinellid sponge in which they appear with the same characters as in *Tethya* is *Aurora*, with its two species, *Aurora globostellata* and *Aurora reticulata;* in the Monaxonids, on the other hand, similar forms of aster are not confined to *Tethya*, *e.g.*, they occur in the new species *Doripleres dendyi*, a sponge which possesses neither a cortex nor a radiate arrangement of the megascleres, and in the widely different species *Dictyocylindrus stuposus*, Bowerbank, one of the Axinellidæ. Again, the transition from an aster without a distinct centrum to one in which the centrum is well developed is so easy, and the transition is so frequently met with, that the spheraster, as distinct from asters with small centrums, is not of much value in classification, it is scarcely of generic value even. Contrary to the opinion of some spongologists, asters are so commonly present among the Monaxonids that the material out of which the spheraster might arise may readily be found within that group. Take the Axinellidæ for example; here we have as aster-bearing sponges:—*Raspailia stelligera*, O. Schmidt[1]; *Dictyocylindrus fasicularis*, Bowerbank[2]; *Dictyocylindrus stuposus*, Bowerbank[3]; *Hymedesmia stellivarians*, Carter[4]; *Hymeniacidon moorei*, Carter,[5] both these last two species with oxyasters; *Hymeniacidon spinatostellifera*, Carter[6]; *Hymeniacidon capitatostellifera*, Carter,[7] characterised by a remarkable form of spheraster; *Hymeniacidon trigonostellata*, Carter,[8] in which the aster is a curious microcalthrops with terminally spined actines, reminding one of a tetralophous microcalthrops; *Axos flabelliformis*, Carter[9]; *Axos cliftoni* (Gray)[10]; *Hymedesmia stellata*, Bowerbank,[11] with a chiaster. In Monaxonids other than Axinellids we have *Sclerochalina asterigena*, O. Schmidt,[12] though it is possible that the asters which Schmidt figures in connection with this may not be proper to the sponge; *Chondrilla sacciformis*, Carter[13]; *Suberites*

[1] Spong. Atlant. Gebiet., p. 60, pl. v. fig. 14.
[2] Mon. Brit. Spong., vol. ii. p. 110; vol. iii. p. 45, pl. xviii.
[3] *Op. cit.*, vol. ii. p. 116; vol. iii. p. 47, pl. xix. figs. 1–7.
[4] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vi. p. 50, pl. iv. figs. 10*a–e*.
[5] *Loc. cit.*, p. 50, pl. iv. figs. 11*a–c*.
[6] *Loc. cit.*, p. 51, pl. iv. figs. 13*a–d*.
[7] *Loc. cit.*, p. 51, pl. iv. figs. 12*a–c*.
[8] *Loc. cit.*, p. 52, pl. iv. figs. 14*a–d*.
[9] *Op. cit.*, ser. 5, vol. iii. p. 285, pl. xxvi. figs. 1–4, 1879.
[10] Bowerbank, Mon. Brit. Spong., vol. i. pl. x. fig. 197; Gray, *Proc. Zool. Soc. Lond.*, p. 546, 1867; and Bowerbank, *Proc. Zool. Soc. Lond.*, p. 321, pl. xxix., 1873; Carter, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. iii. p. 285, pl. xxvi. figs. 5, 6, 6*a–c*.
[11] Mon. Brit. Spong., vol. ii. p. 146; vol. iii. p. 71, pl. xxviii. figs. 5–8.
[12] Spong. Küste von Algier, p. 8, pl. ii. fig. 5.
[13] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. iii. p. 299, pl. xxvi. figs. 9, 11, 12.

stelligerus, Carter[1]; *Vioa johnstoni*, O. Schmidt,[2] and several new species to be described later.

The list of astrophorous Monaxons not directly related to *Tethya* is sufficient to show that the astrophorous character is by no means so very exceptional in the Monaxonid group. A feature which to my mind is more suggestive of affinity to the Stellettidæ is the association of one or more very small asters with the spheraster, one of these smaller forms being sometimes a chiaster with terminally tylote actines, of essentially the same characters as the chiaster of species of *Myriaster* and *Anthastra*, this suspicion of alliance suggested by the association of two asters, one of them a chiaster, is, however, weakened by the fact that the chiaster is a very simple and apparently somewhat primitive form of spicule and might very well be independently evolved in widely different sponges.

The existence of a considerable number of astrophorous Monaxonida requires to be recognised in classification, a task which is much facilitated by the excellent arrangement of the Monaxonid sponges proposed by Messrs. Ridley and Dendy; into this I shall introduce as few changes as possible.

Putting on one side the Homoraphidæ, it will be observed that the Monaxonida of Ridley and Dendy fall readily into two groups, those distinguished by the presence of sigmaspires, sigmas, or chelæ, and those in which the microsclere when present is some form of aster, it may be a euaster, or a spiraster, or some closely related form. I propose, therefore, to recognise these two groups as suborders, the former as the Meniscophora, the latter as the Spintharophora.[3] The Meniscophora will include the family Heteroraphidæ, Ridley and Dendy, and the Desmacidonidæ, O. Schmidt; the Spintharophora, the Axinellidæ, Suberitidæ, Spirastrellidæ, and Tethyidæ, and such other aster-bearing sponges as will be described and discussed later. The Homoraphidæ, since they are without the guiding microsclere, will be relegated to a third suborder, the Asemophora.

It will probably be objected that the Spintharophora include many sponges, and even a whole group of sponges (Suberitidæ), which are totally devoid of microscleres; to this it may be replied that the alliance of these sponges without microscleres to those with which they are associated, is discoverable on other grounds, and that once united to aster-bearing sponges, a group arises to which a name may be given as generally characteristic without being necessarily applicable to every constituent individual, for a name cannot always contain in itself a definition. Further, we have already seen that the absence of a microsclere is a matter of less importance than its character when present (*vide* Introduction), hence when in a natural group of sponges microscleres are generally absent, it becomes a matter of great interest to discover cases in

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vi. p. 124.

[2] *Loc. cit.*, p. 78, pl. vii. fig. 17.

[3] μηνίσκος, ὁ, a lunula; σπινθήρ, ὁ, a sparkle.

which exceptionally they may be present, and if several such cases be found, and in all of them the microsclere belongs to the same group of forms, we may make use of it for further investigation of the affinities of the family; thus the Axinellidæ are usually without microscleres, but in every instance in which they possess them these spicules are some form of aster, hence, *ceteris paribus*, their affinities are with the Spintharophora rather than the Meniscophora; the *Suberites* are defined by Ridley and Dendy as being without microscleres, but Carter has described as a *Suberites* (*Suberites stellifera*)[1] a sponge in which euasters occur, and in the very characteristic *Suberites virgultosa* (Bowerbank), centrotylote microstrongyles are present and these are derived either from a spiraster or a euaster; if from the former I suppose it might be remarked that the species should be included in the Spirastrellidæ; if so, that only supports the argument for assigning the *Suberites* to the Spintharophora, for it admits the close relationship of the *Suberites* to a family distinguished from it by the possession of spirasters.

The difficulty of determining whether a Spintharophorous sponge not possessing microscleres should be assigned to a family distinguished by spirasters, or to one distinguished by euasters, renders the subdivision of the Spintharophora into groups of higher value than families extremely difficult.

The first subdivision may be naturally made into those genera in which spicules of two widely different orders as regards size are present, and those in which the spicules are all of the same order; the latter may be termed Homosclera, the former Heterosclera; the Homosclera are as at present known represented by a single family—the Astropeplidæ, with a single genus and species, but it is possible that the species of the genus *Coppatias*, none of which I have seen, may eventually be found to belong here. The Heterosclera may be divided into two demi, the first the Centrospinthara, in which the asters are euasters, and the second the Spiraspinthara, in which the asters are some form of spiraster. The Centrospinthara will include the two already existing families, Axinellidæ and Tethyidæ, and a third new one, the Dorypleridæ. The Spiraspinthara will include the two existing families, Suberitidæ and Spirastrellidæ, and a third new one, the Scolopidæ, which appears to be intermediate between the other two.

I have already shown in the Introduction to the Tetractinellida the reasons which preclude the acceptance of Vosmaer's two orders, Silicispongiæ and Cornucaspongiæ, or the Chondrospongiæ and Cornucaspongiæ of von Lendenfeld, and I have now to explain why I do not see my way to accepting the two suborders of Vosmaer, the Halichondrina and Clavulina, although these have been adopted by Ridley and Dendy. The Clavulina being that which includes aster-bearing sponges is the only division with which we are immediately concerned. It is defined by my colleagues as follows:—

[1] Carter, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. x. p. 124, fig. 2, 1882.

"Sponge typically corticate. Skeleton usually more or less radiately arranged, with a dermal crust of spicules, which may be either of the same form, as in the main skeleton, or of a special form (spined spirulæ, &c.). Megasclera typically tylostylote. Microsclera, when present, belonging almost invariably to the stellate group; never chelæ or sigmata. Spongin usually absent."

A great deal depends on the exact meaning of the word "typical"; if, as I imagine, it is to be understood as an equivalent to "most usually," then it will be found that there is not a single character in the whole definition which can be maintained as absolutely constant. This is not the fault of the framers, but of the group on which it is framed. Its value as a definition can be still better exemplified by applying it to some particular instance, let us say *Suberites domuncula*, the typical species of the genus *Suberites*, which stands as the first genus of the Clauvulina. The cortex of this is very poorly expressed, no better than that of some Desmacidine species; the arrangement of the spicules is rather less than more radiate and might just as well be termed reticulate; the spicules are, however, tylostyles, and in the cortex though nowhere else are arranged in the typical *Suberite* fashion. In this sponge the most valuable characters are the presence of tylostyles and their radial position in the cortex; by these marks it is recognised at once as a *Suberite*, and in an exceedingly closely allied species we find centrotylote microstrongyles,—microscleres which are always derived from some astral form. The form of the microsclere in *Suberites* is thus traceable to an astral ancestor, and consequently Ridley and Dendy might have dispensed with "almost," and have written without qualification that the miscrosclere in the Clauvulina can "invariably" be traced to an astral origin. If now we extend our survey from the genus *Suberites* we shall find that the tylostyles are inconstant, in the allied genus *Stylocordyla* they are replaced by oxeas, and in the Spirastrellidæ we frequently encounter diactinose in place of monactinose megascleres. The radial arrangement of the cortical spicules further is inconstant, since in the Spirastrellidæ they are tangentially disposed. Thus the only character which is constant whenever present is that of the microsclere.

I now give in tabular form the proposed classification:—

Order MONAXONIDA.

Suborder I. ASEMOPHORA.

With a single family.

Family I. Homoraphidæ, Ridley and Dendy.

Homorrhaphidæ, Ridley and Dendy, Report on the Monaxonida, Zool. Chall. Exp., part lix.

Suborder II. MENISCOPHORA.

Monaxonida in which the microsclere when present is usually a sigmaspire, sigma, or chela, never an aster.

Family I. Heteroraphidæ, Ridley and Dendy.

Heterorrhaphidæ, Ridley and Dendy, *loc. cit.*

Family II. Desmacidonidæ (O. Schmidt), Ridley and Dendy (*emend.*).

Desmacidonidæ, Ridley and Dendy, *loc. cit.*

Suborder III. SPINTHAROPHORA.

Monaxonida in which the microsclere when present is some form of aster, never a sigmaspire, sigma, or chela.

Group I. Homosclera.

Spintharophora in which the spicules are of the same or a similar order, *i.e.*, all microscleres.

Family I. Astropeplidæ.

Homosclera in which the microscleres are microxeas and asters. The microxeas are arranged tangentially to the walls of the canal-system, forming a loose felt. The chamber-system is eurypylous, the ectosome is not a cortex.

Genus 1. *Astropeplus*, n. gen., with a single species, *Astropeplus pulcher*, n. sp.

Group II. Heterosclera.

Spintharophora in which megascleres are always present and sometimes also microscleres.

Demus I. Centrospinthara.

Heterosclera in which the microsclere when present is a euaster.

Family I. Axinellidæ (O. Schmidt).

The ectosome is not a cortex, the mesoderm of the choanosome is collenchymatous, the chamber-system is eurypylous. The skeleton consists of axial fibres and radial fibres proceeding from them to the surface. The megascleres are styles and rhabdi, which may be isoactinate or anisoactinate, or both. The microsclere when present is a spheraster or oxyaster or strongylaster (in one genus, *Tricentrium*, the aster is sometimes a microcalthrops).

Genera.

1. *Hymeniacidon* (Bowerbank), Ridley and Dendy, *loc. cit.*, p. 166.
2. *Phacellia* (Bowerbank), Ridley and Dendy, *loc. cit.*, p. 169.
3. *Ciocalypta* (Bowerbank), Ridley and Dendy, *loc. cit.*, p. 173.
4. *Acanthella* (O. Schmidt), Ridley and Dendy, *loc. cit.*, p. 176.
5. *Axinella* (O. Schmidt), Ridley and Dendy, *loc. cit.*, p. 178.
6. *Raspailia* (Nardo), Ridley and Dendy, *loc. cit.*, p. 188.
7. *Dendropsis*, Ridley and Dendy, *loc. cit.*, p. 191.
8. *Thrinacophora*, Ridley and Dendy, *loc. cit.*, p. 193.
9. *Dictyocylindrus*, Bowerbank, Mon. Brit. Spong., vol. iii., pl. xix. figs. 1–7, vol. ii. p. 116.
10. *Epallax*, n. gen.

Family II. Dorypleridæ.

The ectosome is not a cortex, and the choanosome not regularly folded, the mesoderm is collenchymatous. The megascleres are oxeas arranged without order. The microsclere is a large oxyaster.

Genus 1. *Dorypleres*, n. gen., with a single species, *Dorypleres dendyi*.

Family III. Tethyidæ, Vosmaer.

The ectosome is a well-differentiated cortex with a distinct fibrous layer. The megascleres are strongyloxeas, radially arranged. The microscleres are spherasters, but other forms of euaster are frequently present.

Genera.

1. *Tethya*, Lamarck.
2. *Columnitis*, O. Schmidt.
3. *Xenospongia*, Gray (?).
4. *Magog*, n. gen. (?).

Demus II. Spiraspinthara.

Spintharophora in which the microsclere is some form of spiraster.

Family I. Scolopidæ.

The ectosome is a thin fibrous cortex, containing oxeas and microxeas closely and radially arranged. The megascleres are oxeas, mostly collected in fibres, radially arranged. The microsclere when present is an amphiaster.

Genera.

1. *Scolopes*, n. gen., type—*Scolopes moseleyi*, n. sp.
2. *Stylocordyla*, Wyville Thomson.

Family II. Suberitidæ (O. Schmidt).

The ectosome is a more or less distinctly differentiated cortex, with a skeleton of microstyles radially arranged, palisade fashion. Microscleres are usually absent (except microstyles); in two species—*Suberites ficus* (Bowerbank) and *Suberites virgultosa* (Bowerbank),[1] which are possibly identical, a centrotylote microstrongyle occurs. The megascleres are tylostyles.

Genera.

1. *Suberites* (Nardo), Ridley and Dendy, *loc. cit.*, p. 197.
2. *Polymastia* (Bowerbank), Ridley and Dendy, *loc. cit.*, p. 210.
3. *Proteleia*, Ridley and Dendy, *loc. cit.*, p. 214.
4. *Trichostemma*, Sars, Ridley and Dendy, *loc. cit.*, p. 216.
5. *Tentorium*, Vosmaer, Ridley and Dendy, *loc. cit.*, p. 221.
6. *Quasillina* (Norman), Ridley and Dendy, *loc. cit.*, p. 225.
7. *Cliona* (Grant), Ridley and Dendy, *loc. cit.*, p. 227.

[1] Bowerbank, Mon. Brit. Spong., vol. iii. pls. xxxv., xxxvi.

Family III. Spirastrellidæ, Ridley and Dendy.

Spirastrellidæ, Ridley and Dendy. *loc. cit.*, p. 229.

The megascleres are rhabdi or styles, the microscleres are spirasters or discasters. The microscleres form a dense dermal layer.

Genera.

Spirastrella (O. Schmidt), Ridley and Dendy, *loc. cit.*, p. 229.
Latrunculia, Bocage, Ridley and Dendy, *loc. cit.*, p. 233.
Podospongia, Bocage, Journ. Sci. Math. Phys. et nat. Lisbonne, p. 159, pl. x. fig. 1, 1869.

The Relations of the Spintharophora to the Tetractinellida.

That the Spintharophora are nearly related to the Tetractinellida I do not doubt, but am inclined to think that the connection is not as Vosmaer imagines with the higher Tetractinellida, but with the lowest, such as Placinidæ. If we compare the lowest form of the Spintharophora (*Astropeplus*) with the lowest of the Tetractinellidæ (*Placina*), we cannot fail to perceive a close resemblance, but if for *Placina* we substitute the very nearly related *Placortis simplex* the similarity becomes surprising. With the same general kind of canal- and chamber-system, the prevailing spicules of *Placortis* are diactinose asters, or microxeas, 0·1 mm. in length in *Placortis* and from 0·2 to 0·4 mm. in *Astropeplus;* the chief difference between the two forms lies in the replacement of the triactinose asters of *Placortis* by smaller polyactinose asters in *Astropeplus*, and the importance of this difference, though it is not great, is further lessened by the fact that the actines of the aster in *Astropeplus* are inconstant in number and are frequently reduced to three. The passage from *Placortis* to *Astropeplus* is so easy that one cannot help thinking that *Astropeplus* has been derived from some Placinid form by a variation in the number of actines of the aster, and a slight modification of the microxea, which is seldom of a quite regular form in the Placinidæ. The microxeas of *Astropeplus* may readily pass into megoxeas, and, given these two forms, asters and oxeas, the different spicules of the Spintharophora can readily be derived. In *Epallax,* which probably lies near the root of the Axinellidæ, we find asters similar to those of *Astropeplus,* and oxeas, which in accordance with the mode of growth of the sponge have acquired greatly increased size both in length and breadth. The tendency to pass into strongyles or strongyloxeas is manifested by these spicules, and the strongyloxeas and styles of the more differentiated Axinellidæ are thus foreshadowed. The canal-system and

chamber-system of *Epallax* is scarcely further advanced than that of *Astropeplus*, and it is of great interest to find that the same is true of *Phacellia* as described by Mr. Dendy (Ridley and Dendy, *loc. cit.*, pl. xlix. fig. 3). The Axinellidæ are also nearly related to the Tetractinellida, and the occurrence of microcalthrops described by Carter in *Microciona quadriradiata*[1] and in *Dictyocylindrus rickersii*[2] becomes intelligible as a case of survival. The spheraster of *Dictyocylindrus stuposus*, Bowerbank, and the aster with dichocladal actines of *Dictyocylindrus fasicularis*, Bowerbank, are readily derived from the simple asters of *Epallax*, so too are the small styles which occur in conjunction with the larger rhabdi of so many Axinellidæ, though the passage of these can perhaps be more exactly traced through the microcalthrops of *Tricentrium*; I have described this spicule as presenting various forms of di-, tri-, and tetractinose forms in *Tricentrium muricatum*, Ehlers,[3] and Carter has described a whole series of species in which the selection of one or other of these forms has taken place; thus in *Tricentrium* (*Dictyocylindrus*) *rickersii* (Carter), we have asters with from three to five actines present and serving as "echinating" spicules, in *Tricentrium* (*Microciona*) *quinqueradiata* (Carter), pentactinose asters are present, in *Tricentrium* (*Microciona*) *quadriradiata* (Carter), tetractinose forms (microcalthrops), in *Tricentrium muricatum*, Ehlers, chiefly triactinose forms, in *Tricentrium* (*Microciona*) *curvispiculifera* (Carter), diactinose forms, and in *Microciona* (?) *bulboretorta*, Carter, we reach the style; the smaller "echinating" styles of the Axinellidæ are traceable ultimately to calthrops or asters, and so far afford a justification to Vosmaer's view, by which *Tricentrium* is assigned to the Tetractinellida, but when the whole assemblage of characters is taken into account this view becomes untenable, for the genus *Tricentrium* is evidently an Axinellid and cannot be removed to the Tetractinellida without taking the Axinellidæ along with it.

The Dorypleridæ are readily understood as resulting, so far as the spicules are concerned, from an overgrowth of the oxeas and asters of *Astropeplus*.

The Tethyidæ must be traced backwards towards a Placinid ancestor in order to explain the radiate arrangement of the skeleton, which evidently depends on their mode of growth. If in the case of *Epallax* we regard the vasiform sponge as resulting from the widening of the oscule of the original Rhagon, and a subsequent outward and upward growth of its margin, we shall perceive how the arrangement of spicules which it presents may be brought about, for we have two chief directions of growth,—one from the base along the sides of the cup or radial, this will lead to the over-development of such spicules as happen to be directed along radial lines; the other at right angles to this in the direction of the axes of the chief folds or evaginations of the gastral wall,

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vi. p. 42, pl. iv. fig. 4, 1880.
[2] *Op. cit.*, vol. iii. p. 285, pl. xxvi. figs. 1–4, 1879.
[3] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. iii. p. 19, pl. vi., 1879.

and this will lead to the overgrowth of those spicules which have become the "hispidating" spicules of the sponge; in the Tethyidæ the growth has been of a different character: the original Rhagon has increased from the centre radially, and in accordance the megascleres lie with their long axis in the same direction. Both arrangements are readily derivable from that which occurs in the simpler Tetillidæ, and is represented diagrammatically in Fig. 4, A. In this case the spicules are arranged both concentrically and radially; let the thin-walled vasiform *Epallax* arise from this in the manner described above, and the concentrically arranged spicules will become the chief or axial spicules of the skeleton, as in Fig. 4, B; if, on the other hand, the walls increase in thickness, as in *Tethya* and *Craniella*, then the radial spicules as in Fig. 4, C, form the main and indeed only megascleral skeleton. In the Tetillidæ we can trace the

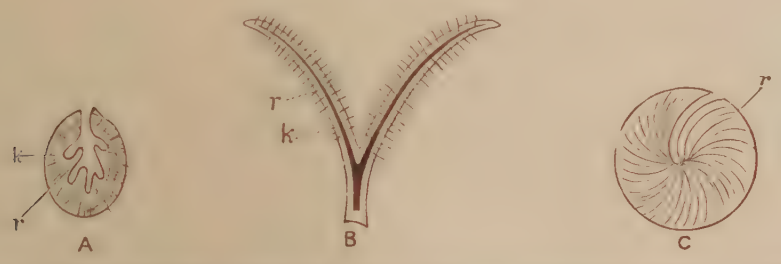


FIG. 4.—A, Primitive arrangement of spicules met with in *Tetilla*. B, arrangement in *Epallax*. C, *Tethya* and *Craniella*; *k*, concentrically, *r*, radially arranged spicules.

transition from the stage shown by A to that of C in Fig. 4, but in the Tethyidæ the earlier stages are lost or remain to be discovered, and only the final term is known to us.

In the Scolopidæ we meet with the palisade arrangement of the cortical oxeas that is already foreshadowed in *Placinastrella*, the only Tetractinellid sponge in which it is so well expressed, though something similar is presented by the cortical oxeas of some of the Geodiidæ; this arrangement persists throughout the Suberitidæ, which probably originally branched off from some point near the root of the Scolopidæ.

DESCRIPTION OF SPECIES.

Order MONAXONIDA.

Suborder III. SPINTHAROPHORA.

Monaxonida in which the microsclere when present is some form of aster, never a sigmaspire, sigma, nor chela.

Group 1. HOMOSCLERA.

Spintharophora in which the spicules are of the same order, *i.e.*, all microscleres.

Family 1. ASTROPEPLIDÆ.

Homosclera in which the microscleres are microxeas and asters. The microxeas are arranged tangentially to the epithelial surfaces forming a felt. The chamber-system is eurypylous, the ectosome is not a cortex.

Genus 1. *Astropeplus*, n. gen.

The only genus.

Astropeplus pulcher, n. sp. (Pl. X. figs. 14, 30).

Sponge (Pl. X. fig. 14, *c*).—A thin, incrusting plate, scarcely 1 mm. in thickness; surface smooth, even. Pores 0·02 to 0·025 mm. in diameter, generally distributed, leading into extensive subdermal chambers. Oscules also small, about 0·4 mm. in diameter, irregularly distributed. Ectosome thin, densely crowded with asters and tangentially arranged microxeas; choanosome with scanty collenchymatous mesoderm and eurypylous flagellated chambers.

Spicules.—I. Microscleres. 1. *Microxea*, fusiform, slightly curved, varying in size, on an average 0·226 by 0·0065 mm., but when directed obliquely from the base towards the surface frequently larger, 0·387 by 0·013 mm.

2. *Aster* (Pl. X. fig. 30), very variable, centrum absent, actines conical, straight, usually strongylate, sometimes oxeate, usually from two to six in number, frequently four, and then producing a microcalthrops, each actine then 0·019 mm. in length. Sometimes, especially in the ectosome, the actines are more numerous and the aster smaller, the total diameter frequently not exceeding 0·0118 mm.

Habitat.—St. Iago, Porto Praya; incrusting *Sphinctrella cribrifera* and *Calthropella simplex.*

Remarks.—This sponge closely resembles *Placortis simplex*, F. E. Schulze, from which it differs by the larger size of the microxea and the smaller size and greater number of the actines of the aster. If we suppose the triod of *Placortis* to develop fresh actines, becoming smaller in the process, and the microxea to lengthen and to acquire a more constant and regular fusiform outline, we shall arrive directly at *Astropeplus*.

The spicules of the *Calthropella simplex* on which the sponge is seated, occur mixed along with those proper to it, so that mingled with the asters in the ectosome of *Astropeplus* we find the characteristic spheraster of the *Calthropella*. This furnishes another indication of the extrusion of spicules from a sponge during life.

Group II. HETEROSCLERA.

Spintharophora in which megascleres are always present, and sometimes microscleres in addition.

Demus I. CENTROSPINTHARA.

Heterosclera in which the microsclere when present is a euaster.

Family 1. AXINELLIDÆ (O. Schmidt).

Centrospinthara in which the ectosome is not a cortex, the mesoderm of the choanosome is collenchymatous, the chamber-system is eurypylous. The skeleton consists of axial fibres, and radial fibres proceeding from them to the surface. The megascleres are styles and rhabdi, which may be isoactinate or anisoactinate, or both. The microsclere when present is a spheraster or strongylaster or oxyaster, and in one genus, *Tricentrium*, sometimes a microcalthrops.

Genus 10. *Epallax*.

The choanosome is a regularly folded plate, the sinuses of the folds on one face are the main excurrent canals, on the other face the main incurrent canals. The spicules are large oxeas and asters, the former partly arranged in longitudinal fibres cemented by spongin.

Epallax callocyathus, n. sp. (Pl. X. figs. 1–12).

Sponge (Pl. X. fig. 1).—Vasiform, expanding towards the margin, above which it is rounded and gently undulating, produced into a short, slender, strong stalk below, by which it is attached. Oscules small, opening into the interior of the cup in radiating linear series, those of adjacent rows irregularly alternating with each other. Pores in cribriform areas lying over the incurrent canals, which interdigitate with the excurrent canals, both crossing the walls of the sponge transversely in linear, longitudinal rows.

Both inner and outer surface rendered thinly hispid by slender projecting oxeate spicules, which extend further from the surface in the lower and interior part of the vase than elsewhere.

Ectosome, thin, collenchymatous. Choanosome, mesoderm a collenchyma, flagellated chambers eurypylous, about 0·0275 to 0·0395 mm. in diameter, often oval in section, then, 0·0434 by 0·0353 mm. in diameter.

Spicules.—I. Megascleres. 1. *Axial oxea* (Pl. X. fig. 3), stout, fusiform, obtusely pointed, straight or curved; 3·034 by 0·0774 mm.

2. *Hispidating oxea* (Pl. X. fig. 2), slender, cylindrical, sharply pointed, 3·927 by 0·0387 mm.

II. Microscleres. 3. *Aster*, with few actines (Pl. X. fig. 6), centrum absent, actines variable in number, most frequently four, then usually of calthrops form, sometimes less, three or two, then producing a centrotylote microxea, or only one; sometimes more, as many as five or six. The inclination of the actines is also variable, sometimes a tetractinose form is not a microcalthrops but a staurus, and a triactinose form may resemble a staurus with one actine suppressed. The variations in the form of this spicule are similar to those of the corresponding spicule in *Thenea*. The actines are conical, strongylate, and slightly roughened towards the ends; they measure 0·0276 by 0·004 mm.

4. *Asters*, with several actines. These differ from the preceding in presenting slightly smaller dimensions and somewhat more numerous actines, usually six to eight in number. Length of a single actine, 0·008 mm.

Colour.—White, of a faint greyish tinge.

Habitat.—Station 192, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud. Trawled.

Remarks.—Only a single specimen of this elegant vase-shaped sponge was trawled. It measures 73 by 51 mm. across the brim; its total height is 46 mm.; the thickness of the wall about 3 mm.; the rigid stem is 12 mm. high and 6 mm. thick.

The interdigitating excurrent and incurrent canals cross the wall transversely, so that in transverse section the choanosome appears more or less regularly folded (Pl. X. fig. 10). Branches looking like minor folds proceed from both sets of canals, which subdivide till only a single layer of flagellated chambers intervenes between their ultimate ramifications.

The ectosome, averaging about 0·318 mm. in thickness, is a collenchymatous layer coated by epithelium, which on the incurrent face is subdivided into an outer layer which is perforated by the pores, and which forms the roof to widely extending subdermal cavities; and an inner layer which forms the outer ends of the choanosomal folds, and from which it arises by the suppression, where it occurs, of flagellated chambers below. Immediately over the wide apertures of the incurrent canals the poriferous roof alone is found. The outer ectosomal layer of the poriferous face is of variable thickness, about

0·1 mm. on an average; over the entrance to the incurrent tubes it is perforated by a single wide oval aperture, over the inner end of which an exceedingly thin cribriform membrane extends—the poriferous roof.

The endosome or hypophare of the excurrent face is similar to the ectosome, except that no poriferous roof extends over the openings of the excurrent canals; at the same time these canals do not each open by a single aperture, but by several perforations which traverse the endosome immediately over them. The excurrent canals expand towards their termination, so as to produce cavities within the endosome corresponding with the subdermal cavities of the incurrent face.

The ectosome is densely crowded with calthrops-like asters, and faced with a dense layer of smaller asters. Both kinds of spicules are richly dispersed through the choanosome, the smaller asters chiefly occurring below the epithelial surfaces, and the calthrops between the flagellated chambers, to which they form a spicular framework (Pl. X. fig. 11).

Running through the middle of the sponge-wall, and destroying the regular disposition of the canals where they occur, are longitudinal bundles of the stout oxeas, which are irregularly coated with spongin; the spongin appears to be most developed where the spicules lie in closest contact; in one instance the remains of sponginoblasts were observed coating the spongin.

The mesoderm consists of collenchyma, which for the most part is present as a very thin layer, owing to the abundant development of the flagellated chambers; in places, however, it acquires a greater thickness. It contains not only the usual collencytes, but granular cells like those described in *Pœcillastra schulzii* (p. 81, Pl. IX. fig. 25), here however not so numerous. They are about 0·02 mm. in diameter, the large oval nucleus measures 0·016 by 0·0118 mm. in diameter, and the spherical nucleolus is 0·003 mm. in diameter.

The axial oxea is subject to considerable modification of form, it frequently terminates prematurely in rounded ends, and sometimes, though rarely, becomes tylote at one extremity. Occasionally it passes into a globular form, and globules thus formed by the reduction of the oxea sometimes occur united several together into a single mass (Pl. X. figs. 7–9).

Family II. Dorypleridæ.

Centrospinthara in which the ectosome is not a cortex, and the choanosome is not regularly folded; the mesoderm is collenchymatous. The megascleres are oxeas arranged without order. The microsclere is a large oxyaster.

Genus *Dorypleres*, n. gen.

As this is the only genus I refrain from giving a diagnosis.

Doripleres dendyi, n. sp. (Pl. XLII. figs. 12–19).

Sponge (Pl. XLII. fig. 12).—An irregular hollow cylinder, with walls of unequal thickness, open at both ends. Surface hispid in places, especially near the base, elsewhere covered by a smooth shining membrane, marked by deep branching grooves, arranged in stellate groups. Oscules small, situated in the floor of the superficial grooves. Pores small, singly distributed.

Spicules.—I. Megascleres. 1. *Somal oxea* (Pl. XLII. fig. 13), fusiform, thick, straight or curved, oxeate or tornote, 2·06 by 0·097 mm.

2. *Ectosomal* (hispidating) *strongyloxea*, cylindrical, 1·12 by 0·013 mm.

II. Microscleres. 3. *Somal spheraster* (Pl. XLII. figs. 14–17), centrum somewhat small, about 0·015 mm. in diameter; actines conical, oxeate, about ten in number, sometimes more numerous, sometimes reduced to two, total diameter 0·1 mm.

4. *Ectosomal spheraster*, centrum, though absolutely smaller, relatively larger than in the preceding spicule, 0·0118 mm. in diameter; actines conical, oxeate, about eighteen to twenty in number, total diameter 0·04 mm.

Colour.—Greyish-white.

Habitat.—Station 192, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud. Trawled.

Remarks.—The single specimen of this sponge, which is complete, measures 45 mm. in diameter, and 37 mm. in height, the central cavity is 18 mm. wide, the wall on one side 20 mm. in thickness, on the other 7 mm.

The somal oxeas are thickly scattered through the sponge, apparently without any trace of arrangement; where they cross each other they are usually bound together by spongin. It is impossible to cut thin slices of this sponge, the spicules tearing the tissue to rags. From such observations as I was able to make, the choanosomal mesoderm appeared to be collenchymatous, and I conclude that the flagellated chambers are probably eurypylous. The somal spherasters occur throughout the sponge, but immediately beneath the skin they are supplemented by the smaller ectosomal spherasters. The pores vary from about 0·02 to 0·04 mm. in diameter. The stellate systems of grooves on the surface are remarkably similar to those which occur in the case of several Lithistid sponges.

Amongst the spicules obtained from the sponge by boiling out with nitric acid are a few small tylotoxeas (Pl. XLII. figs. 18, 19), which may possibly belong to it, but may quite as probably be foreign inclusions.

Family III. Tethyidæ (Vosmaer).

Centrospinthara in which the ectosome is a well-differentiated cortex, with a distinct fibrous layer. The megascleres are rhabdi, radially arranged. The microscleres are spherasters.

Genus 1. *Tethya*, Lamarck.

Tethyidæ of more or less spherical form, in which the rhabdus is a strongyloxea. The chamber-system is diplodal.

Tethya seychellensis (E. P. Wright) (Pl. XLIV. figs. 1–6).

Alemo seychellensis, E. P. Wright, Trans. Roy. Irish Acad., vol. xxviii. (Sci.), p. 13, pl. i., 1881.

Sponge (Pl. XLIV. fig. 1).—More or less spherical, attached or free, surface conulose, conules gemmiferous, varying in form according to position and the presence, state of development, or absence of gemmæ. Oscules one or more in number; pores in sieves, situated in the depressions between the conules, leading into extensive intercortical cavities (Pl. XLIV. fig. 4).

Spicules.—I. Megasclere. 1. *Strongyloxea*, fusiform, anisoactinate, esactine strongylate, ecactine tapering to a narrower termination than the esactine, but rarely exactly oxeate, sometimes tornote, but usually strongylate; 1·91 by 0·023 mm. (Station, Samboangan), 1·68 by 0·026 mm. (Station 186).

II. Microscleres. 2. *Cortical spheraster*, centrum large, actines conical, oxeate, usually from twenty to twenty-four in number, 0·095 mm. (Station, Samboangan), 0·064 mm. (Station 186) in diameter.

3. *Somal chiaster*, centrum variable, sometimes absent, sometimes well marked; actines cylindrical, varying in length, diameter, and number, terminally tylote; 0·0118 mm. in diameter.

4. *Choanosomal aster*, very variable, actines slender, straight or curved, conical, oxeate, irregularly spined, or cladose, dichotomising irregularly, once or oftener; the length of a single actine 0·0276 mm.; centrum small or absent.

Colour.—Greyish-white in spirits; on upper surface light ruddy-brown (E. P. W.).

Habitat.—Station 186, Flinders Passage, September 18, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; bottom, coral mud. Dredged.

Samboangan.

South-east of Mahé, Seychelles Islands, inner margin of a coral reef; August 1867 (E. P. W.).

Remarks.—The faithful description and illustrations given by Perceval Wright of this sponge render its identification an easy task. Two fine specimens, both in an excellent state of preservation, are in the Challenger collection, a fortunate circumstance, considering the deplorable loss of the type which was sent to Weimar, never to return.

The tylote chiasters, which are very frequently sexradiate triaxons, are met with also in *Tethya maza*, Sk., *Tethya ingalli*, Bwk., and *Tethya japonica*; the remarkable cladose asters of the choanosome are more characteristic; but similar spicules occur in *Tethya ingalli*, Bwk., which is distinguished by its completely fibrous cortex. A similar representative spicule occurs in *Tethya maza*, but is distinguished by the form of the actines, which are cylindrical, shorter, and generally roughened. In *Tethya japonica* cladose asters are absent, and as far as I can make out unrepresented. The alliance of *Tethya maza*, *Tethya seychellensis*, *Tethya japonica*, and *Tethya ingalli* is unquestionably very close, and as regards the first three, I am inclined to regard them as varietal modifications of a single species.

The specimen of *Tethya seychellensis* from Samboangan has a very different external appearance to that from Station 186, a difference which depends on a difference in the size and form of the conules and condition of the oscule. The specimen from the latter station is 31 mm. by 26 mm. in length and breadth by 24 mm. in height; it is attached by a broad base, and presents a single oscule situated at the summit. The oscule is widely open, about 6 mm. in diameter, and surrounded by a membranous margin; it leads into a cloaca which receives some five or six somewhat large excurrent canals. The texture is loose. Most of the conules are very small, under 1 mm. in diameter, and they present a very interesting series of variations, which may serve to explain the differences of appearance presented by different specimens of *Tethya lyncurium*, differences so great that they seem at first sight of specific importance. Here these differences are united in perfect gradation in one and the same individual. In the simplest case the conules are small and conical, and marked by lateral rounded ridges which radiate from the summit, and pass continuously into similar ridges proceeding from adjacent conules, thus forming a network with polygonal, frequently triangular meshes (Pl. XLIV. fig. 7). Within these meshes the surface is depressed and occupied by a pore-sieve. The appearance thus produced is somewhat similar to, but not quite identical with, that so well represented by Schulze in his account of *Aphysilla aërophoba*, N.[1]

In the next stage the ridges about the sides of each conule have increased in breadth, and present a flattened upper surface. As this change commences from the conule and extends outwards, so the middle part of the ridges remains for some time unaffected and contrasts by its smooth rounded upper surface with the flat scar-like summit of the region nearer the conule; in other words, each conule is now surrounded with its own system of flattened ridges, but these remain connected with those of adjacent conules by a bridge of

[1] *Zeitschr. f. wiss. Zool.*, Bd. xxx. pl. xxii. figs. 4–6.

unchanged character. The broadening of the flattened ridges continues till each conule with its ridges becomes a wide polygonal plate, with denticulated or crenate margins, and the interconular spaces are reduced to narrow crevices between them. The extension of the conule in this fashion may proceed till the lobes of the marginal crenations fuse with those of adjacent conular plates, reducing the intervening crevices to a linear series of minute canals. With the final extension of the conule the scar-like appearance of the surface vanishes.

These changes in the characters of the conules are related partly to the gemmation of the sponge, partly to the position of the oscule. Near the oscule, and I may add near the base of the sponge, the conules are usually of the plate-like form, possibly because in these regions there is a minimum of instreaming water, owing to fewer flagellated chambers occurring in their vicinity. Large pore-sieves are not required in these positions, and the conules enlarge for support and protection. The connection with gemmation is as follows:—The buds are first protruded at the ends of the conules, upon which they are at first sessile, but subsequently extended on the end of a stalk; they then drop off and leave a flat scar behind, from the middle of which is sometimes produced a short spicular style. The extension of the scar over the radiating ridges of the conule may be due to the base of the stalk being carried away by the bud, and such is, I think, the case in many instances; in others it would appear due to the appearance of fresh buds from the sides of the conule after the first have been formed and liberated. Several buds, mostly measuring about 1·5 by 0·9 mm. in length and breadth, are still adherent to many of the conules near the base of the sponge. Some of these were examined in serial sections, but in none was a trace of a flagellated chamber found. They are solid throughout, and present no other structure than is to be found in the outer layer of the cortex. In form they are generally oval, but produced at the distal end into tent-like projections, into which the strongyloxeas of the interior project. Beneath an investing epithelial layer follows a single layer of cells, each containing a chiaster like that of the adult sponge; this is succeeded by a tissue composed in varying proportions of oval granule-cells and fusiform fibrillated cells. Near the exterior the granule-cells predominate, almost to the exclusion of the fibrillated cells; in the interior the fibrillated cells, the granule-cells there occurring only sparingly scattered through the fibrous tissue. The granule-cells are about 0·012 to 0·0158 mm. in breadth by 0·0198 mm. in length; they consist of spherical, deeply staining, homogeneous granules, about 0·0025 mm. in diameter. Spherasters are absent, and the strongyloxeas present no evidence of a triæne derivation.

The specimen from Samboangan is free, with a rounded base, 31 to 28 mm. in diameter by 31 mm. in height; the summit is raised into a rounded conical eminence, formed of closely apposed lozenge-shaped conular plates, which conceal the oscule (Pl. XLIV. figs. 1, 3). The texture is much firmer than that of the preceding specimen.

The conules are larger, polygonal, and plate-like; a central style rises from the middle of some of them—the remains of a bud stalk (Pl. XLIV. fig. 2). The corners of the conular plates are either confluent with those of adjacent plates, or united by short united rounded ridges; the pore-sieves lie in the deep depressions between the conules. Only one bud remains attached, and that is situated on the side of the oscular eminence. It measures 6 mm. in length and 4 mm. in diameter, and is supported by a stalk 5 mm. long, which appears to be continued through it, projecting for 4 or 5 mm. distally beyond it. Its surface is smooth, and a section shows the presence of a thick fibrous cortex, apparently not differentiated into two layers, but containing spherasters. There is no sign of an oscule.

From the scarred surface of the conules and comparatively large size of the only bud remaining attached, it would appear that some time had elapsed since the sponge produced its last crop of buds; it is therefore with interest that we find the choanosome abundantly crowded with ova, which occur throughout it in all regions alike (Pl. XLIV. figs. 4–6). Each ovum lies in a cavity of the choanosome, corresponding in shape with itself, but of much greater dimensions, a difference no doubt due to the contraction which occurred on placing the sponge in spirits. The wall of the cavity is lined with epithelium, and between this and the ovum occurs a finely granular film, sometimes adherent to the ovum, sometimes to the wall, or sometimes partly to both; this appears to be a coagulated albuminous substance (Pl. XLIV. fig. 6, *alb*). The ovum is oval, about 0·075 by 0·063 mm. in length and breadth, with a well-defined darkly stained outer wall (vitelline membrane?); finely and evenly granular contents, and an excentrically placed, deeply staining, round nucleus, 0·0075 mm. in diameter. The including cavity measures 0·095 by 0·138 mm. in length and breadth.

The general anatomy of both specimens is similar, the intercortical cavities are well developed, and in the characters of the choanosome and canal-system there is no divergence from the structure of the typical species, *Tethya lyncurium*.

Tethya japonica, n. sp. (Pl. XLIV. figs. 7–14).

Sponge (Pl. XLIV. figs. 7, 8).—Spherical, attached, conules rounded, gemmiferous. Pores in sieves leading into extensive intercortical cavities (Pl. XLIV. fig. 11). Oscule not visible. Cortex differentiated into an outer and inner layer.

Spicules.—I. Megasclere. 1. *Strongyloxea*, of the usual form, 1·51 by 0·026 mm.

II. Microscleres. 2. *Cortical spheraster*, actines oxeate, simple, numerous; centrum 0·035 mm. in diameter; total diameter of spheraster 0·067 mm.

3. *Somal* and *choanosomal chiaster*, similar, actines cylindrical, tylote; 0·0118 mm. in diameter.

Colour.—Greyish-white.

Habitat.—Station 208, off Manila, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; depth, 18 fathoms; bottom, blue mud. Trawled.

Remarks.—There are two specimens of this sponge, one nearly 20 mm. in diameter, and the other 13 mm. The larger specimen (Pl. XLIV. fig. 7) is gemmiferous.

Tethya ingalli, Bowerbank (Pl. XLIV. figs. 15, 16).

Tethea ingalli, Bowerbank, Proc. Zool. Soc. Lond., p. 119, pl. v. figs. 11–17, 1872.
„ *cliftoni*, Bowerbank, *op. cit.*, p. 16, pl. iii. figs. 14–18, 1873.
„ *robusta*, Bowerbank, *op. cit.*, p. 10, pl. ii. figs. 12–17, 1873.
Tethya cliftoni, Ridley, "Alert," p. 624, 1885.
? „ „ Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xvii. p. 122, 1886.

Sponge (Pl. XLIV. fig. 15).—More or less spherical, attached, surface smooth, without conules, but raised into low rounded bosses. Cortex (Pl. XLIV. fig. 16) thick, not differentiated into an outer and inner layer, fibrous throughout. Pores simple, singly distributed, chiefly over the depressions between the mammillation of the surface, leading each into a long narrow canal of uniform diameter, which completely traverses the cortex. Intercortical cavities absent. Oscules similar to the pores, but sometimes larger, not exceeding 0·5 mm. in diameter.

Spicules.—I. Megascleres. 1. *Strongyloxea*, as in the genus, 1·6 to 1·7 mm. in length by 0·026 to 0·032 mm. in diameter.

II. Microscleres. 2. *Cortical spheraster*, as in the genus, from 0·065 to 0·085 mm. in diameter.

3. *Somal chiaster*, as in *Tethya seychellensis*, E. P. W., from 0·0118 to 0·0157 mm. in diameter.

4. *Choanosomal oxyaster*, centrum absent, actines slender, straight or curved, usually few in number, frequently six, arranged along three rectangular axes; erectly spined; rarely dichotomising; spines few, varying in number and length, irregularly distributed; total diameter of the spicule, 0·035 to 0·043 mm.

Colour.—Orange-red when living, pinkish-grey in spirits.

Habitat.—Station 162, off East Moncœur Island, April 2, 1874; lat. 39° 10′ 30″ S.; long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells. Dredged.

Port Jackson; depth, 6 to 15 fathoms.

Distribution.—Fremantle, Australia (*Tethea ingalli*, Bowerbank, &c.; *Tethea cliftoni*, Bowerbank, *loc. cit.*); Australia (*Tethea robusta*, Bowerbank, *loc. cit.*); Port Phillip Heads, Australia (*Donatia* (*Tethea*) *cliftoni*, Bowerbank, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xviii. p. 463, 1886); Seychelles, depth, 12 fathoms (Ridley, *loc. cit.*).

Remarks.—I have examined types of *Tethya cliftoni* and *Tethya ingalli*, and find no specific difference between them. The character on which Bowerbank relied for their

separation was a supposed difference in the distribution of the spherasters within the cortex; this does not exist.

It would appear possible that the sponge described by Ridley from the Seychelles as *Tethya cliftoni*, Bowerbank, may really be *Tethya seychellensis*, E. P. W.; while again it is possible, though not highly probable, that these two species may be identical. The chief character on which the distinction of *Tethya ingalli* rests is the absence of any marked differentiation in the tissue of the cortex, which is wholly fibrous throughout. Associated with this is the absence of intercortical cavities.

Two specimens were obtained by the Challenger, the larger is 45 mm. in diameter, and even in spirits retains a reddish tint. The smaller is only 9 mm. in diameter. The cortex is a solid fibrous felt throughout, and in the larger specimen it measures a little over 3 mm. in thickness. Spherasters are not generally distributed through it, but form a layer beneath the surface, 0·95 mm. thick; they extend, together with chiasters, along the course of the radial cortical canals, and are thickly crowded through the choanosome for some distance beneath the cortex.

Demus II. Spiraspinthara.

Spintharophora in which the characteristic microsclere is some form of spiraster.

Family I. Scolopidæ.

The ectosome is a thin fibrous cortex, containing oxeas and microxeas radially arranged, palisade fashion. The megascleres are oxeas mostly collected into fibres, radially arranged. The microsclere when present is an amphiaster. The canal-system is probably eurypylous.

Genus 1. *Scolopes.*[1]

Scolopidæ in which an amphiaster is present, the sponge is not provided with a stalk, and is not of symmetrical form.

Scolopes moseleyi, n. sp. (Pl. XLIII. figs. 1–9).

Sponge (Pl. XLIII. fig. 1).—Large, massive, surface even, uniformly pilose; oscules and pores (?). Cortex densely spiculous.

Spicules.—I. Megascleres. 1. *Oxea* of the spicular fibres (Pl. XLIII. fig. 2), fusiform,

[1] σκόλοπες, *oi*, a palisade, stockade. The singular, σκολοψ, has been used with various modifications for more than one genus already, but not, so far as I am aware, the plural.

straight or somewhat curved, stout, abruptly pointed, 2·25 by 0·06 mm. 2. *Oxea* of the cortex (Pl. XLIII. fig. 3), cylindrical to fusiform, straight or curved, abruptly pointed, 0·556 by 0·013 mm. 3. *Microxea* of the cortex and choanosome (Pl. XLIII. fig. 4), cylindrical, straight, abruptly pointed, 0·125 by 0·004 mm.

II. Microsclere. 4. *Amphiaster* (Pl. XLIII. figs. 5–7), axis short, cylindrical; actines in terminal whorls, none in continuation of the direction of the axis; 0·007 by 0·003 mm.

Colour.—Greyish-white.

Habitat.—Bahia.

Remarks.—The single specimen of this sponge is a fragment of a more or less cake-like mass, with one surface flattened, and the opposite irregularly undulating; it measures 113 mm. in breadth by 120 mm. in length and 65 mm. in thickness. The fractured surface seems to have passed through the middle of the sponge, and reveals the coarse spicular fibres which radiate somewhat spirally from an excentric node towards the surface, beyond which the component spicules project for about 0·4 mm., forming the first line of defence of the cortex (Pl. XLIII. figs. 8, 9); between these are packed the oxeas of second size (No. 2), they project for about 0·24 mm., and are more numerous than the larger oxeas; finally, forming the most superficial and most densely packed layer of spicules, follow the microxeas (No. 3), which do not project for more than 0·05 mm. The microxeas are also scattered through the choanosome, and are especially numerous about the surface of the larger canals, into the lumen of which they project.

The spicules of the cortex are bound together by a fibrous collenchyma.

The amphiasters are scattered generally throughout the sponge. They sometimes present an accessory whorl of actines around the middle of the axis, and then are suggestively similar to a "Sceptrella." The Scolopidæ would thus appear to be nearly related to the Spirastrellidæ.

It is impossible, such is the impenetrability of the close palisade of cortical spicules, to obtain tangential sections, and thus one cannot determine the characters of the pores, neither can satisfactory radial sections be obtained by the paraffin method; nothing but freezing can succeed in a case like this, and I leave this to subsequent observers. The mesoderm of the choanosome appears to be a granular collenchyma, and the flagellated chambers are eurypylous.

The general character of the spicular skeleton reminds one forcibly of that in Carter's genus *Trachya*, and that of the cortex is distinctly Suberitic; indeed, were the oxeas replaced by tylostyles, one would not hesitate to place the sponge with the Suberitidæ.

Account of other known Species of Spintharophora not in the Challenger Collection.

Demus I. Centrospinthara.

Family I. Axinellidæ.

Genus 11. *Hemiasterella.*

Hemiasterella typus, Carter.

Hemiasterella typus, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. iii. p. 146, pl. xxi. fig. 9, 1879.

Sponge.—Cyathiform (bowl-shaped), with thin walls, and deeply dentated irregular edges; proliferous on the inner side. Substance cork-like. Surface rugosely reticulate on each side, covered with an incrustation of small asters, and hispidated by long setaceous strongyloxeas. Pores and oscules not conspicuous.

Spicules.—I. Megascleres. 1. *Strongyloxea*, curved, 1·67 by 0·0278 mm.

II. Microsclere. 2. *Choanosomal aster*, actines variable in number, from four to eight, oxeate, centrum absent, 0·035 mm. in diameter. 3. *Somal aster*, similar, but smaller, and with more numerous actines.

Size, 275 mm. by 100 mm. across the brim, 150 mm. deep, wall 4·16 mm. thick.

Habitat.— (?).

Remarks.—This appears to closely resemble *Epallax callocyathus* (see p. 423), Should subsequent examination prove the two sponges to be congeneric, my name must be suppressed in favour of Carter's.

Family II. Dorypleridæ.

Dorypleres affinis (Carter).

Hemiasterella affinis, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. iii. p. 147, pl. xxi. fig. 10, 1879.

Sponge.—Long, narrow, cylindroconic; excavated by a conical cavity extending nearly the whole depth of the sponge; proliferous on the outward surface. Surface rugosely reticulate; covered with an incrustation of small asters, hispidated by long oxeas. Pores and oscules not conspicuous.

Spicules.—I. Megasclere. 1. *Oxea*, fusiform, curved, 1 by 0·0278 mm.

II. Microscleres. 2. *Choanosomal aster*, centrum small or absent, actines oxeate,

four to ten in number, 0·0417 mm. in diameter. 3. *Somal aster*, smaller, with slenderer and more numerous actines than the preceding asters.

Colour.—White. Size, 125 mm. in height; orifice 6·3 mm., lower end 37 mm. in diameter.

Habitat.—(?).

Family III. Tethyidæ.

Genus 1. *Tethya*, Lamarck.

Tethya lyncurium, Lin. (Pl. XLIII. figs. 15–18; Pl. XLIV. figs. 17–19).

Tetie sferica, &c., Donati, Nat. Mar. dell' Adriat., p. 62, pl. x. fig. 1, 1750.
Alcyonium lyncurium, Lin., Syst. Nat., p. 1295, 1767.
Alcyonium aurantium, Pallas, Elench. Zooph., p. 357, 1776.
Tethya lyncurium, Lamk., Mém. d. Mus., t. i. p. 71, 1815; Hist. Anim. sans vert., t. ii. p. 386, 1816.
Alcyonium lyncurium, Lamx., Polyp. flexibles, p. 343, 1816.
Spongia verrucosa, Montagu, Mem. Wern. Nat. Hist. Soc., vol. ii. p. 117, pl. xiii. figs. 4–6, 1818.
Tethya spherica, Flem., Brit. Anim., p. 520, 1828.
Donatia lyncurium, Nardo, Isis, p. 522, 1833.
Tethya lyncurium, Blain., Man. d'Actinologie, p. 544, pl. xci. fig. 3, 1834.
Tethea lyncurium, Johnst., Brit. Spong., p. 85, woodcut 12, 1842.
Tethya lyncurium, vars. *nodulosa* and *contorta*, and *Tethya morum*, O. Sch., Spong. Adriat. Meeres, pp. 44, 81, 1862.
„ „ Bwk., Mon. Brit. Spong., vol. i. p. 182, pl. xxv. fig. 342, 1864; vol. ii. p. 92, 1866.
Donatia aurantium, Gray, Proc. Zool. Soc. Lond., p. 541, 1867.
Tethya lyncurium, O. Sch., Spong. Algier, pp. 22, 31, pl. iv. fig. 8, 1868.
Donatia aurantium, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. iv. p. 6, pl. ii. fig. 1, 1869.
Tethya lyncurium, O. Sch., Spong. Atlant. Gebiet., p. 51, 1870.
Tethea norvagica, Bwk., Proc. Zool. Soc. Lond., p. 121, pl. v. figs. 18–25, 1872.
Tethya lyncurium, Bwk., Mon. Brit. Spong., vol. iii. p. 38, pl. xv. figs. 17–22, 1874.
Donatia aurantium, Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xvi. p. 81 (sep. copy), 1875.
Tethya lyncurium, Dezsö, Archiv f. microsk. Anat., Bd. xvi. p. 626, pls. xxx.–xxxiii., 1878; Bd. xviii. p. 151, pl. xii., 1879.
„ „ Bwk., Norman, Mon. Brit. Spong., vol. iv. p. 44, 1882.
„ „ var. *obtusum*, Vosmaer, Niederländ. Archiv f. Zool., Suppl.-Bd. i. p. 25, pl. iv. figs. 123–126, 1882.
Donatia aurantium, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. xi. p. 363, 1883.
„ „ Carter, Proc. Acad. Nat. Sci. Philad., pp. 202, 209, 1884.
Tethya lyncurium, Vosmaer, Bijdr. Dierk., vol. xii. p. 10 (sep. copy), 1885.

Sponge.—More or less spherical, attached, sessile. Surface even or raised into mammillary bosses, which receive the corymbose termination of the skeletal fibres, pilose. Oscules small, one or more in number—frequently none are visible. Pores in sieves extending between the mammillæ, leading into more or less extensive intercortical cavities;

or single, and then forming the simple termination of a long narrow canal, which completely traverses the cortex. Cortex thick, usually differentiated into a collenchymatous outer and a fibrous inner layer.

Spicules.—I. Megasclere. 1. *Strongyloxea*, of the same form as in *Tethya ingalli* and *Tethya seychellensis*, from 1·6 by 0·0193 mm. to 2·54 by 0·0387 mm.

II. Microscleres. 2. *Cortical spheraster*, very variable in form, centrum always large, actines conical, oxeate; smooth or sparsely spined, or dichotomose; from 0·039 to 0·097 mm. in diameter.

3. *Somal* and *choanosomal asters* similar; both very variable, a centrum is usually present, the actines are conical or cylindrical, oxeate, or more usually truncate or strongylate, from 0·0118 to 0·02 mm. in diameter.

Colour.—Dull orange to bright chrome-yellow when alive, greyish-white in spirit.

Habitat.—Mediterranean Sea:—the Adriatic (Quarnero, Zlarin, Lesina, Corfu), coast of Algiers. English Channel:—South Devonshire (Plymouth, Budleigh Salterton, Torquay), Cornwall (Towey Harbour), Sussex (Hastings), Guernsey (Tremaine Bay, 13 fathoms), Brittany (Roscoff, Isle of Douon, lowest spring tides). Atlantic Ocean:—Ireland (Westport Bay, county Mayo and Connemara), West Florida. German Ocean:—Norway (from Trondjheim to the North Cape; Kors Fjord, 180 fathoms). Arctic Ocean:—Lat. 71° 12·5′ N., long. 20° 30′ E., 135 fathoms; lat. 72° 9′ N., long. 24° 42′ E., 145 fathoms.

Remarks.—The general agreement of zoologists to call this sponge *Tethya lyncurium* is opposed by Carter, who advocates the claims of *Donatia aurantium*. In the following short history justification is found for the accepted view. Partly owing to the well-marked characters of the sponge, partly to the truthfulness with which they are portrayed by Donati, there is no mistaking the species which this clear-sighted observer intended in his description commencing "Tetie sferica . . . ." These two words, however, do not constitute a name in the Linnean sense, and, as they are pre-Linnean, may be dismissed. Linnæus then named the sponge *Alcyonium lyncurium* (1767), and "*lyncurium*" as the specific designation is therefore happily inalienable.

Pallas, however, in his excellent description (1776) unfortunately adopted another, and the name "*aurantium*" given by him is that advocated by Gray and Carter; I do not precisely see on what grounds. The sponge is so readily recognised, even without microscopical examination, that it must have been perfectly well known to the naturalists of Linnæus's time and to their immediate successors; Lamarck and Lamouroux identify it and adopt Linnæus's name without hesitation.

The discussion is thus narrowed down to the selection of the generic name. Lamarck is author of the genus *Tethya*, or as he sometimes spelt it "*Tethea*," but under this name

he included several not very closely connected sponges, and of these, two in particular, evidently of different generic value, have been made the subject of controversy. These are *Tethya cranium* and *Tethya lyncurium*. For one of these it became necessary to create a new genus; and it is claimed by Gray and Carter that the first to recognise this was Nardo, who in 1833 proposed the genus *Donatia* to receive *Tethya lyncurium;* and if the genus *Donatia* were so contrived as to cut *Tethya lyncurium* adrift from *Tethya cranium*, the contention would of course be successful. Neither Nardo's definition, however, nor the species which he enumerates in illustration, bear out this supposition, The definition runs as follows:—"*Donatia, aggregata tuberosa, rigida, tenacia, fere pumicosa in sicco, sarcoidea ponderosa in vivo, superficie varia, sæpe porosa, fulcimenta aculeiformia conspicua, rigida, simplicia vel polycuspidata quandoque granulosa in aggregatorum superficie, dispositione varia, pulpæ animalis ope coalita.* Species: *Donatia lyncurium* N., *cydonium* N.; *cuspidaria* N.; *obvolvens* N.; *longaculea* N.," &c.

There is nothing in this piece of latinity exclusive of *Tethya cranium*, and as to the other species, all that we know of "*cydonium*" points to its *Geodine* character. *Donatia* may be regarded as a mere synonym of *Tethya;* nor could we expect much better when we call to mind that Nardo divided all sponges into three orders, including between them altogether not more than twelve or fourteen genera. Had Nardo not found a friendly exponent in Schmidt, his generic names would probably have all long ago been forgotten.

The exclusion of *Tethya cranium* we owe to O. Schmidt (1862); the revised definition of the genus for which he retained the name *Tethya* is as follows:—*Tethya*, Lamarck; *corticatæ globosæ vel subglobosæ, cute crassa, fibrillis distincte contexta et corpuscula stellata continuente obductæ. Spicula simplicia fasciculata e centro vel e nucleo subcentrali radiantia usque ad superficiem.*

By this definition and the citation of *Tethya lyncurium* as an instance, Schmidt has stamped the name *Tethya* upon *Tethya lyncurium* indelibly, and thus the "orange of the sea," as Lamouroux called it, will now always be known as *Tethya lyncurium*, Linn. For *Tethya cranium*, Schmidt proposed the new name *Craniella cranium*. An attempt to reverse this nomenclature was made five years later by Gray, who retained the name *Tethya* for *Tethya cranium*, and coined a fresh designation, *Donatia aurantium*, for *Tethya lyncurium*. The proposal was made too late, and would lead to much inconvenience; had it been suggested before Schmidt's restricted definition of *Tethya* was published, the name *Donatia* would probably have found wider acceptance; now it naturally meets with no support, always with the important exception of Carter's ingenious advocacy.

The variations of this, as of most well-known sponges, are so extreme, that it would need a laborious examination of a large series of specimens to define the limits of individual and collective differences. O. Schmidt at first (1862) recognised two

species, *Tethya morum* and *Tethya lyncurium*; the latter with two varieties, besides the type, occurring in the Adriatic. Subsequently (1868) he suppressed *Tethya morum*, regarding it as identical with *Tethya lyncurium*. In this I have no doubt he was right, and the varieties may *à fortiori* be suppressed too.

The northern form, *Tethya norvagica*, Bowerbank (*Tethya lyncurium*, var. *obtusum*, Vosmaer ?), is distinguished from the Mediterranean by its smaller size. Bowerbank examined a considerable number of specimens, and states that they vary from 4 to 15 mm. in diameter; and Dr. Norman's specimens, which I have examined, seldom exceed 5 or 6 mm. The cortex is comparatively thin, less than 1 mm. in thickness; and in a fragment of one of Bowerbank's types the spicules measured as follows:—Strongyloxea 1·6 by 0·0193 mm.; cortical spheraster 0·04 mm. in diameter; somal aster 0·012 mm. in diameter. The last named spicule exhibits a curious tendency to pass into a globule, with a somewhat nodose surface; this results from the reduction of the actines, rather than the overgrowth of the centrum, though both are concerned. In Dr. Norman's specimens the cortical spheraster is larger, 0·058 mm. in diameter, and is distinguished by the tendency of the actines to dichotomise. The examples from the British seas, though frequently larger than those from Norway, do not seem to be characterised by larger spicules. Thus a specimen I obtained from Roscoff measured about 25 mm. in diameter, and its cortex 4 mm. in thickness, but the spicules are scarcely larger than those in Dr. Norman's Norwegian specimens. Thus the strongyloxea measures 1·7 by 0·026 mm., and the cortical spheraster 0·058 mm. in diameter.

Bowerbank does not give measurements of the spicules in the British specimens he examined, but measurements taken from his drawings almost exactly correspond with those of my Roscoff specimen. He gives the thickness of the cortex as varying from 2 to 6 mm.

The Mediterranean examples are characterised by much larger spicules than the Norwegian and British. From a portion of one of O. Schmidt's types I obtained the following measurements:—Strongyloxea 2·54 by 0·0387 mm.; cortical spheraster 0·097 mm. in diameter; somal aster 0·02 mm. in diameter. It would appear possible, therefore, that three varieties may eventually be distinguished,—the type-species, characterising the Mediterranean, a South British variety and a North British and Norwegian variety.

Tethya bistellata, O. Schmidt.

Tethya bistellata, O. Schmidt, Spong. Adriat. Meeres, p. 45, pl. vii. fig. 1, 1862.

Sponge.—As in *Tethya lyncurium.*

Spicules.—I. Megasclere. 1. *Tylotoxea.*

II. Microsclere. 2. *Spheraster*, partly of the usual form, partly with the actines

arranged in two groups, radiating from opposite poles; the centrum 0·055 mm. in diameter.

Colour.—Red.

Habitat.—South coast of Lesina, two miles from the shore.

Tethya diploderma, O. Schmidt.

Tethya diploderma, O. Schmidt, Spong. Atlant. Gebiet., p. 52, pl. iv. fig. 11, 1870.

Sponge.—As in *Tethya lyncurium*.

Spicules.—I. Megasclere. 1. *Strongyloxea*, as in *Tethya lyncurium*.

II. Microscleres. 2. *Spheraster*, actines short, 0·03 mm. in diameter. 3. *Aster*, actines six to nine in number, often curved, with occasional tubercles, terminally tylote, 0·0085 mm. in diameter.

Habitat.—Antilles.

Remarks.—The structure of the cortex, which Schmidt seems to think exceptional, appears to me precisely similar to that of small specimens of *Tethya lyncurium*, such as occur in the variety *Tethya lyncurium*, var. *norvagica*.

Tethya (?) *innocens*, N., O. Schmidt.

This is mentioned by O. Schmidt (Spong. Atlant. Gebiet., p. 51) as uniting genuine Suberite tylostyles with asters.

Tethya repens, O. Schmidt.

Tethya repens, O. Schmidt, Spong. Atlant. Gebiet., p. 51, 1870.

Sponge.—A long crust, 10 mm. thick in the middle, with numerous flat papillæ, into which spicular bundles enter.

Spicules.—I. Megascleres. 1. *Strongyloxea*, somewhat strongylate at the ecactinal end. 2. *Strongyle*, and 3. *Tylotoxea*, smaller than the strongyloxea.

II. Microsclere. 4. *Spheraster*, like that of *Tethya lyncurium*, with dichotomose actines.

Habitat.—Florida.

Remarks.—Although not mentioned by Schmidt, probably other asters besides the spheraster are present. The sponge may possibly be assignable to the genus *Columnitis*.

Tethya (?) stellata, O. Schmidt.

Cometella stellata, O. Schmidt, Spong. Atlant. Gebiet., p. 49, pl. iv. fig. 10, 1870.
Tethya cometes, O. Schmidt, Spong. Meerb. Mexico, p. 78, 1880.

Sponge.—A spherical body supported by a long slender stalk, surface raised into numerous rounded papillæ, so that the whole sponge resembles a stalked mulberry.

Spicules.—I. Megasclere. 1. *Strongyle*, sometimes fusiform, sometimes cylindrical.

II. Microscleres. 2. *Somal spheraster*, as in *Tethya lyncurium*. 3. *Radical spheraster*, smaller, and distinguished by longer, often tuberculate actines.

Habitat.—Cuba; depth, 317 to 344 fathoms; also lat. 24° 8′ N., long. 82° 51′ W., and lat. 23° 13′ N., long. 89° 16′ W.; 84 to 329 fathoms.

Tethya maza, Selenka.

Tethya maza, Selenka, Zeitschr. f. wiss. Zool., Bd. xxxiii. p. 472, pl. xxviii., 1879.

Sponge.—Spherical, attached; surface conulose, conules gemmiferous. Pores in sieves leading into extensive intercortical cavities. Oscule single, situated at the summit. Cortex differentiated into an outer and inner layer.

Spicules.—I. Megasclere. 1. *Strongyloxea*, of the usual form in the genus, 1·68 by 0·032 mm.

II. Microscleres. 2. *Cortical spheraster*, of the usual form, but characterised by very variable actines, sometimes conical and oxeate; they are more frequently conical and strongylate, and then usually bear one or more spines, or they may dichotomise.

3. *Somal chiaster*, as in *Tethya seychellensis*, E. P. W., 0·0118 mm. in diameter.

4. *Choanosomal chiaster*, of excessively variable form; actines usually few, six or seven in number, slender, cylindrical, roughened rather than distinctly spined; very rarely dichotomose; centrum usually absent; total diameter 0·0237 mm.

Colour.—Orange-yellow when alive, in spirits greyish-white.

Habitat.—Bay of Rio Janeiro, between tides (Selenka).

Remarks.—Through the kindness of my colleague, Dr. E. P. Wright, I have been able to examine typical specimens of this sponge. Its distinction from *Tethya seychellensis*, E. P. W., rests entirely on the difference in form of the choanosomal aster.

Budding, according to Selenka, takes place during the winter season, but not continuously; the buds originate in the cortex, and in such numbers as to almost obliterate the intercortical cavities. They then glide out along one of the spicular fascicles of the conules, and remain attached till their development is nearly complete, when they drop off. The oscule and subcortical cavities are not developed till after complete separation from the parent.

Tethya multifida (Carter).

Donatia multifida, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. ix. p. 358, pl. xii. fig. 22, 1882.

Sponge.—Membraniform, lacinulate, expanded, flat or erect, fan- or vase-shaped, proliferous. Texture hard, tough. Surface even, presenting white lines (spicular-fibres) radiating from the excentric expansions to the circumference, which is fimbriated by irregular lacinulate processes of variable length, ending in thin expansions, by which they become adherent, like the tendrils of a scandent plant, to surrounding hard objects (empty shells, &c.); terminal expansions of the processes charged with microscleres.

Spicules.—I. Megasclere. 1. *Strongyloxea*, straight or slightly curved, with a slight tendency to pass into a tylotoxea; when fully grown the ecactine is somewhat roundly pointed, 1·92 by 0·035 mm.

II. Microscleres. 2. *Spheraster*, 0·044 mm. in diameter.

3. *Somal chiaster*, sexradiate, centrum spherical, actines straight, terminally tylote, 0·0125 mm. in diameter. 4. *Choanosomal oxyaster*, actines three to six in number, straight or crooked, branched or spined irregularly, centrum absent, 0·0415 mm. in diameter.

Colour.—Pinkish. Size, 25 mm. in diameter exclusive of the external filaments.

Habitat.—Acapulco, west coast of Mexico; depth, 4 to 9 fathoms.

Remarks.—As I have not seen this sponge I have departed but little from the text of Carter's description. The spicules, notwithstanding the difference in the general appearance of the sponge, are those of a typical *Tethya*, and call to mind those of *Tethya seychellensis* in particular.

Genus 2. *Columnitis*, O. Schmidt.

Tethyidæ of irregular form, incrusting; the spicular fibres rising in vertical columns from the base to the upper surface.

Columnitis squamata, O. Schmidt.

Columnitis squamata, O. Schmidt, Spong. Atlant. Gebiet., p. 25, pl. v. figs. 3, 4, 1870.
" " Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 27, 1873.
" " F. E. Schulze, Zeitschr. f. wiss. Zool., Bd. xxix. p. 10, 1877.

Sponge.—A highly irregular lobate mass; involving fragments of shells with the cortex. Surface almost uniformly facetted with hexagonal areas, about 1 mm. in diameter. The edges of the facets are coloured deep brown; a groove runs over them, which first appears on the completely formed parts of the sponge; over the membranous

parts the borders of the facets are raised into an elevated margin. The grooves are provided with a proper wall, consisting of colourless fibres, densely ensheathed in a brown cell-substance. Within each hexagonal area rises a low cushion-like prominence, into which bundles of spicules rising vertically from the base of the sponge enter in columnar groups, and radiately project beyond the surface.

The fibrous cortex is sharply distinguished from the choanosome, its fibrous tissue is continued inwards as the walls of the canals.

Spicules.—I. Megasclere. 1. *Tylotoxea*, arranged in bundles, which rise vertically from the base.

II. Microscleres. 2. *Spheraster*. 3. *Chiaster*, actines cylindrical, numerous, curved, or minutely tubercled.

Colour.—Black, in spirits.

Habitat.—Antilles.

Remarks.—The alliance of this sponge with *Tethya* has been pointed out by Carter (*loc. cit. supra*).

Genus 3. *Magog*.[1]

Tethyidæ in which the rhabdus spicule is an oxea, which is confined to the choanosome.

From Carter's description it would appear that the oxeas are not arranged in radiating spicular fibres. In this and the presence of chones the genus differs widely from *Tethya*.

Magog sacciformis (Carter).

Chondrilla sacciformis, Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. iii. p. 299, pl. xxvi. figs. 9, 11, 12, 1879.

Sponge.—Massive, depressed, produced into cylindrical hollow lobes, sessile. Surface even. Pores the single openings of chones uniformly distributed; oscules situated at the ends of papillæ scattered generally over the surface, or singly terminating the saccular lobes.

Spicules.—I. Megasclere. 1. *Oxea*, fusiform, curved, 1·0 by 0·028 mm.

II. Microsclere. 2. *Spheraster*, centrum very large; actines correspondingly short, numerous, conical, rounded off near the end, or truncate, or slightly expanded and minutely tubercled; centrum 0·09 mm. in diameter, actines 0·013 mm. long, total diameter 0·116 mm.

[1] Magog, the name of a giant, popularly represented as armed with a "morning star."

Colour.—Dark brown. Size of the largest saccular lobe 37 mm. in length by 13 mm. in diameter.

Habitat.—Mauritius.

Remarks.—The specimen on which this species is founded is in the dried state; as we are quite ignorant of the characters of the canal-system, its position cannot be definitely determined. I owe to Mr. Carter's kindness a slide containing mounted spicules of the sponge, but I have not seen the sponge itself. A thick fibrous cortex, such as this sponge possesses, is usually associated with an aphodal or diplodal canal-system.

Genus 4. *Xenospongia*, Gray.

Xenospongia, Gray, Proc. Zool. Soc. Lond., p. 229, 1858; p. 547, 1867.
„ Carter, Ann. and Mag. Nat. Hist., ser. 4, vol. xvi. p. 81 (sep. copy), 1875; ser. 5, vol. ix. p. 357, 1882; vol. xvii. p. 44, 1887.

Tethyidæ (?) in which the cortex in part consists of a felt of spicules, traversed by bundles of strongyloxeas; the oscules occur in linear series at the bottom of superficial grooves.

Xenospongia patelliformis, Gray.

Xenospongia patelliformis, Gray, Proc. Zool. Soc. Lond., pp. 129, 130, pl. xii., 1858.
„ „ Carter, Ann. and Mag. Nat. Hist., ser. 5, vol. ix. p. 357, pl. xii. fig. 32, 1882.

Sponge.—Free, subcircular, patelliform. Lower surface with a thick coat of agglutinated sand grains. Upper surface with a white leathery cortex, formed of felted spicules, traversed by bundles of strongyloxeas, which project as hispidating tufts of nearly equal size; a circumferential series of these tufts surrounds the margin of the sponge. The upper surface is marked with a system of well-defined grooves with raised edges; a single subcircular groove occurs near the apex, diverging branches extend from it down the sides, subdividing once, twice, or rarely three times as they proceed, and terminate just before reaching two circular grooves which lie near the margin of the sponge concentric with it. The oscules occur in a single series at the bottom of the grooves. Smaller circular apertures are arranged in rows outside the grooves; these may be pores.

Spicules.—I. Megascleres. 1. *Strongyloxea*, 2·8 mm. in length.

II. Microscleres. 2. *Oxyaster*, centrum not sharply marked off from the actines, which are acutely conical, 0·074 mm. in diameter. 3. *Spheraster*, minute, with short conical actines, 0·024 mm. in diameter.

Habitat.—Torres Strait.

Remarks.—Gray instituted a new family, Xenospongiadæ, and a new order, Arenospongia, for the special reception of this sponge; Carter included it as a genus of his subfamily Donatina, of the family Suberitida; later, while retaining it in the Suberitida he removed it from the Donatina and proposed a new subfamily, Xenospongina, to receive it.

Vosmaer[1] thinks it not impossible that *Xenospongia patelliformis*, Gray, is, if not identical with *Polymastia hemispherica* (Sars), Vosmaer, yet at all events very nearly related to it. It is certainly not identical, and the presence of asters would seem to preclude any very close connection; if the two sponges should prove to be more nearly related than we at present think, an additional argument would be furnished for the Spintharophorous character of the Suberitidæ.

The sponge is no doubt very remarkable and aberrant, but till we know more of its structure, particularly of the cortex, its position must remain more or less doubtful; in the meantime I place it with the Tethyidæ, to which its spiculation appears to ally it.

LIST OF STATIONS AT WHICH SPINTHAROPHOROUS MONAXONID SPONGES WERE OBTAINED, WITH THE SPECIES FROM EACH.

St. Iago, Porto Praya, Cape Verde Islands; August, 1873; depth, 100 to 128 fathoms.

Astropeplus pulcher.

Bahia.

Scolopes moseleyi.

Station 162. Off East Moncœur Island, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells. Dredged.

Tethya ingalli, Bowerbank.

Port Jackson; depth, 6 to 15 fathoms.

Tethya ingalli.

Station 186. Flinders Passage, September 18, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; bottom, coral mud. Dredged.

Tethya seychellensis, E. P. Wright.

[1] Bronn's Klass. u. Ord. d. Thierreichs, Porifera, p. 238.

STATION 192. September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud. Trawled.

Epallax callocyathus. | *Doripleres dendyi.*

Samboangan, Philippines.

Tethya seychellensis.

STATION 208. Off Manila, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; depth, 18 fathoms; bottom, blue mud. Trawled.

Tethya japonica.

SYSTEMATIC INDEX.

(*Italics* are used for Synonyms.)

	Plate	Page
aaptos (*Ancorina*),	...	205
abyssi (*Corticium*),		282
abyssi (Pachastrella),	xi.	xxvii, xc, cxi, cxix, **104**, 110
abyssi (Thrombus),	...	**282**
abyssorum (Craniella),	...	50
acervus (Ecionema),		cxxx, cxxxvi, cxl, **196**, 198
Aciculites,	...	clvii, 347
aculeata (Corallistes),	...	**338**
ægogrophila (Esperia),	...	xlv
aërophoba (Aplysilla),	...	428
æruginosa (Anthastra),	...	**183**
æruginosa (*Stelletta*),	...	183
affinis (Dorypleres),	...	**434**
affinis (*Hemiasterella*),	...	434
affinis (Rhaphidotheca),	...	lxxi
agariciformis (*Dorvillia*),	...	95
agariciformis (*Stelletta*),	...	67, 95, 205
agariciformis (*Tethya*),	...	95
agariciformis (*Tisiphonia*),	...	67, 95, 408, 409
agariciformis (*Wyville-Thomsonia*),	...	95
agassizi (Characella),	...	**101**
Alectona,	...	cxxvi
Algol,	...	cxxxvi, cxxxvii, cxli, cxlii, 200
amphiaster (Discodermia),	...	**331**
Amphibleptula,	...	clix, 351
Amphius,	...	cxlii, 177
amygdaloides (*Pachastrella*),	...	99, 101
amygdaloides (Pœcillastra),	...	**99**
anancora (Pilochrota),	xiv.	**132**
anceps (Astrella),	...	**181**
anceps (*Stelletta*),	...	181
Ancorina,	...	cxxxv, cxxxvii, cxxxix, 188
annulata (Sphinctrella),	...	**100**
annulata (*Stellettinopsis*),	...	206
annulata (*Tisiphonia*),	...	91, 100
annulatus (Asteropus ?),	...	**206**
Anomocladidæ,	...	clix, 354
anonymus (Samus),	...	cxxxi, **57**
Anoplia,	...	clvii, 319, 349
antarctica (*Tethya*),	...	42
antarctica (Tetilla),	...	**42**
Antares,	...	274
Anthastra,	...	xli, cvii, cxxxvi, cxxxvii, cxxxviii, 138, 287, 389
apiarium (*Caminus*),	...	268
apiarium (Isops ?),	xliii.	lxii, **268**
arabica (*Geodia*),	...	262
arabica (*Tethea*),	...	42
arabica (Tetilla),	...	**42**
arabicum (Cydonium),	...	**262**
archeri (Amphora) [Diatom],	...	148
arctica (Rinalda),	...	xci, xcii
areolata (Geodia),	...	**246**
areolata (Pachymatisma),	...	**244**
Asemophora,	...	415
aspera (Characella),	xl.	cxxix, **92**
aspera (Discodermia),	...	**327**
aspera (*Stelletta*),	...	193
asterigera (Sclerochalina),	...	412
asteroides (*Racodiscula*),	...	327, 332
Asteropus,	...	cxii, cxlii, 205, 206
Astrella,	...	cxxxvi, cxxxvii, cxxxviii, 136
Astrobolia,	...	337
Astropeplidæ,	...	416, 422
Astropeplus,	...	xxvii, lxxxvii, 416, 419, 422
Astrophora,	...	cxiii, cxxvii, 59
Astylospongia,	...	cxviii
atropurpurea (Craniella),	...	cxxiii, **50**
atropurpurea (*Tethya*),	...	50
aurantium (*Alcyonium*),	...	435
aurantium (*Donatia*),	...	cxxii, 435
aurea (Darwinella),	...	xlvii
Aurora,	...	cxxxvi, cxxxvii, cxxxix, 187

	Plate	Page
australiense (Ecionema),	...	**196**
australiensis (*Stelletta*),	...	196
australiensis (Tetilla ?),	...	lxv, cxxiii, **43**, 205
avita (Collectella),	...	**408**
Axinellidæ,	..	417, 423, 434
AZORICA,	...	xxi, xxvii, cxvii cxviii, clviii, 319 349, 400
azorica (Macandrewia),	...	clv, **340**, 341
Azoricidæ,	...	clviii, 319, 349
bacca (*Stelletta*),	...	205
bacillifera, var. robusta (*Stelletta*),	...	197
bacilliferum, var. robustum (Ecionema),	...	**197**, 199
barbata (Cinachyra),	III., XXXIX.	xxxv, xliii, lxxxviii xc, cxxiv, cxxv, 11 12, **23**, 55, 403
barretti (*Cydonium*),	...	cxliii, 250
barretti (Geodia),	...	xxxii, xli, xci 249, **250**
baretti, var. nodastrella (Geodia),	...	**247**
BATTERSBYIA,	...	cxxxiii, 108
berryi (Cydonium),	...	**256**
bistellata (Tethya),	...	**438**
boglicii (Stelletta),	...	cxxxix, **184**
borealis (Corallistes),	...	**407**
bowerbanki (Corallistes),	...	301, **308**
bowerbankii (*Craniella*),	IV.	80
bowerbanki (*Dactylocalyx*),	...	308
bucklandi (*Battersbyia*),	...	108
bucklandi (Dercitus),	...	cxxxiii, **108**
bucklandi (*Halina*),	...	108
bucklandi (*Hymeniacidon*),	...	108
bucklandi (*Pachastrella*),	...	108
bulboretorta (Microciona),	...	420
Bursaria [Infusorian],	...	xciv
CALCABRINA,	...	cli, 280
CALLIPELTA,	...	clv, 309
callipelta (*Corallistes*),	XXXVIII.	309
callocyathus (Epallax),	X.	xxvi, lxix, lxxxiii **423**, 434
CALTHROPELLA,	...	cxi, cxii, cxxxiii cxxxiv, clv, 107
calyx (Discodermia),	...	295, 298, **327**
CAMINUS,	...	lxxxvi, cix, cxxxv cxliii, cxlv, cxlvi cxlviii, 214
canaliculata (Geodia),	...	247, **254**
candelabrum (Corticium),	...	xxi, cli, **280**
candidata (Papyrula),	...	cxli, **199**
capitato-stellifera (Hymeniacidon),	...	**412**
capitatum (Siphonidium),	XXXVII.	cvi, cxvii, **317**
carbonaria (*Stelletta*),	...	192
carbonarius (Stryphnus),	...	**192**
carinata (*Geodia*),	...	272
carinata (Placospongia),	XL.	**272**, 273
carteri (Coppatias),	...	**208**
carteri (Craniella),	I.	xl, xli, 31, **35**, 39
carteri (Erylus),	...	**239**
carteri (Geodia),	...	**247**, 257
carteri (*Stellettinopsis*),	...	208
casula (*Tethya*),	...	43
casula (Tetilla),	...	lxxxv, **43**
Centrospinthara,	...	416, 423, 434
cerebrum (Ancorina),	...	cxxxix, **188**
challengeri (Thrombus),	VIII.	xxi, xxxix, lxxxiii clii, **275**
CHARACELLA,	...	cix, cx, cxxix, 91 409
chonellides (Azorica),	...	**349**
chonellides (*Seliscothon*),	...	349
Choristida,	...	xcix, cxxi, 1, 403
CHROTELLA,	...	lxxvii, lxxxvi, cviii cxxv, 17
cidaris (Kaliapsis),	...	cliv, **334**
CINACHYRA,	...	xxxiii, lxxxv lxxxvi, cviii, cxxiv cxliv, 23
cingalensis (Pilochrota),	...	**180**
Cladopeltidæ,	...	clvii, 317, 348
cladosus (Triptolemus),	XXXV.	cxxxi, **93**
clausa (Sulcastrella),	...	cliv, **337**
clava (Rimella),	...	cliv, **335**
clavatella (*Discodermia*),	...	341
clavatella (Macandrewia),	...	**341**
clavatella, var. nodosa (*Discodermia*),	...	342
clavosa (Myriastra),	XII.	xxvii, xxxii, xxxiv **116**
clavosa, var. quadrata (Myriastra),	...	**118**
clavosa (*Stelletta*),	...	116
cliftoni (Axos),	...	**412**
cliftoni (*Donatia*),	...	431
cliftoni (*Tethea*),	...	431
CLIONA,	...	cxxvi
coactura (*Ecionema*),	...	184
coactura (Stelletta),	...	**184**
COLLINELLA,	...	cliv, 336
collingsii (Stelletta),	...	**185**
collingsii (*Tethea*),	...	185
columnifera (Tethyopsis),	...	cxl, **190**
COLUMNITIS,	...	439, 441
cometes (Tethya),	...	440
communis (Anthastra),	XIII., XV.	xxviii, xxxiv, xlviii lxxxvi, xc, **140**
complicata (Rachella),	...	clii, **281**
complicatus (*Samus*),	...	281
compressa (*Ecionema*),	...	cxxx, 98
compressa (Pœcillastra),	...	**98**
conchilega (*Geodia*),	...	262
conchilegum (Cydonium),	...	**262**
connectens (Pachastrella),	...	**111**
connectens, var. (*Pachastrella*),	...	110
contorta (Isops),	...	**271**

	Plate	Page
contorta (*Pachymatisma*),	...	271
cooksoni (Cydonium),	...	255
copiosa (Placinastrella),	...	lxxii, lxxxiv cxxxii, **103**
Coppatias,	...	cxii, cxxxii, 206 414
Corallistes,	..	xxvii, cxviii, clv 301, 338
Corallistidæ,	..	cliv, 301, 338
coriacea (*Stellettinopsis*),	...	207
coriaceus (Coppatias),	...	cxlii, **207**
coronida (Tetilla),	xxxviii.	**6, 9**
corticata (Algol),	...	cxli, cxlii, **200**
corticata (*Stellettinopsis*),	...	200
Corticella,	...	clii, 281
Corticidæ,	..	cxiii, cli, 279
Corticium,	..	cli, 280
Craniella,		lxxxvi, cviii, cxii cxiii, cxxvi, cxxxv cxliv, 30, 421
cranium (*Alcyonium*),	...	51
cranium (Craniella),	v.	xxxvi, cix, cxxi cxxii, cxxiv, 32 38, 50, **51**, 54, 55 437
cranium (*Tethea*),		51
cranium (*Tethya*),		cxxi, 51, 53, 437
cranium (*Tetilla*),	...	51
cranium, var. *abyssorum* (*Tethya*),	...	50
cranium, var. *acufera* (*Tethya*),	...	52
cranium, var. *australiensis* (*Tethya*),		43
cranium, var. *infrequens* (*Tethya*),	...	53
cranium, var. *robusta* (*Tethya*),	...	48
cranium, var. *typica* (*Tethya*),	...	51
cranium, var. *zetlandica* (*Tethya*),	...	55
crassa (*Normania*),	...	cxxx, 98
crassa (Pœcillastra),	...	80
crassicula (Myriastra),	...	**179**
crassicula (*Stelletta*),	...	179
crassispicula (Pilochrota),	xiv.	**128**, 132
crassiuscula (Azorica),	xxxv.	**324**
crassiuscula (*Normania*),	...	83
crassiuscula (Pœcillastra),	...	**83**
cribrifera (Sphinctrella),	x.	**87**
cribrifera (Sympyla),	...	**353**
cribrifera (*Vulcanella*),	...	87
cribrophora (*Azorica*),	...	353
curvispicula (*Microciona*),	...	420
curvispicula (Tricentrium),	...	420
Cydonium,	...	xxxiv, cxliii cxlviii, 218
cydonium (*Alcyonium*),	...	254

	Plate	Page
cylindrigerus (Erylus),	...	**240**
Dactylocalyx,	...	cxv, clv
dactyloidea (*Tethya*),	...	44
dactyloidea (Tetilla),	...	**44**, 48
Dædalopelta,	...	clv, 342
decidua (Poritella),	...	clviii, **351**
delicata (Thenea),	vi., viii.	xvii, xxxviii, cxii **60**, 63, 66, 78
dendyi (Doripleres),	xlii.	**426**
densum (Ecionema),	...	cxxxvi, **197**
depressa (*Geodia*),	...	258
depressum (Cydonium),	...	**258**
Dercitus,	...	cxi, cxxviii, cxxxiii cxxxiv, 108
Desmacidonidæ,	...	xxix, 416
dilopha (Placina),	...	lxxxiii, **278**
diploderma (Tethya),	...	**439**
Dirabdosa,	...	cxlix, 251, 260
discifurca (Discodermia),	xxxii.	cxvii, **292**
Discodermia,	...	cxv, cliii, 292
discophora (*Stelletta*),	..	cxxxv, cxxxvi, 237
discophora (*Triate*),	...	cxliii, 237
discophorus (Erylus),	...	**237**
dissimilis (Disyringa),	xviii., xli.	xxx, xxxiv, lxxxv cxl, 27, **161**
dissimilis (*Tethyopsis*),	...	161
dissoluta (Discodermia),	...	**328**
Disyringa,	...	xxx, xxxiii, cxxxvi cxxxvii, cxl, cxli cxliv, 161, 405
Ditriæna,	...	cxlix, 252, 262 267
domunculus (Suberites),	...	415
dorsigera (Astrella),	...	**182**
dorsigera (*Stelletta*),	...	182
Dorvillia,	...	cxxviii
Dorydermia,	...	cxviii
Dorypleres,	...	426
Dorypleridæ,	...	417, 425
Dotona,	...	cxxvi
Dragmastra,	...	cxxxvii, cxxxix cxliv, 137
dysoni (*Geodia*),	...	269
dysoni (Isops),	...	**269**
echinoides (*Halyphysema*),	...	95, 96
echinoides (*Stelletta*),	...	95
Ecionema,	...	cxxx, cxxxvi cxxxvii, cxl, cxli 195
Ectyon,	...	lxxxvii
elegantior (Corallistes),	...	**338**
elegantissima (Corallistes),	...	**338**
eosaster (Cydonium),	xx., xxi.	**225**, 261
Epallax,	...	xxvii, clii, 417 419, 420, 421, 423
Epipolasidæ,	...	177, 205
Epistylis [Infusorian],	...	xciv
equalis (Hippospongia),	...	xxxv
Erylina,	...	209, 237

	Plate	Page
Erylus,	...	xxxiii, lxxxvi, cix, cxxxv, cxxxvii, cxliii, cxlv, cxlvi, cxlvii, 209
Esperia,	...	xvi, xlv
Euasterina,	...	138, 183
Euastrosa,	..	112
Euastrosa (Appendix to),	...	177
euastrum (Antares),	...	274
euastrum (*Stelletta*),	..	239
euastrum (*Stellettinopsis*),		274
euplocamus (Tetilla),		cxxiv, 45, 48
Euspongia,	...	xxxix, 22
exostitus (Calthropella ?),	...	111
exostitus (*Pachastrella*),	...	111
Fangophilina,	..	55
fascicularis (Dictyocylindrus),	...	412, 420
fenestrata (Thenea),	viii.	xxix, 71, 73
fenestrata (*Tisiphonia*),	...	71
ferruginea (Theonella),	...	326
fibrosa (*Ancorina*),	...	180
fibrosa (Pilochrota),	..	180
fibulifera (Stelletta),	...	204
flabelliformis (Axos),	...	412
flabelliformis (Scleritoderma),	xxxv.	316
flemingii (Geodia),	...	252
formosus (Erylus),	xxviii.	xlvi, 209
fortis (*Stelletta*),	...	192
fortis (Stryphnus),	..	192
Gastrophanella,	...	clviii, 349
geminum (Tremaulidium),	...	clix, 352
geniculata (Tetilla),		lxvi, cxxiii, 46
Geodia,	...	xi, xlv, cxxxv, cxliii, cxlv, cxlvii, cxlviii, 244
Geodia sp.,	..	lxxxvii
geodides (Psammastra),	..	200
geodides (*Stelletta*),	..	200
Geodiidæ,	...	lxxx, cxii, cxliii, 209, 237, 404
geodiides (Calthropella),	...	87, 108, 111
Geodina,	...	218, 244
geodina (*Stelletta*),	..	265
geodinum (Cydonium),	...	265
geodioides (*Pachastrella*),	...	111
gibberosa (Geodia),	...	cxliii, cxlix, 249
gibberosa (*Geodia*),	...	260
gibberosa (Geodia),	...	244
gibberosum (Cydonium),	..	260
gigas (Cydonium),	...	xxii, 258
gigas (*Geodia*),	...	258
gigas (Pilochrota),	xx.	xli, xlii, 124
glariosum (Cydonium),	xx., xl.	cxlv, 223
globa (Isops),	...	268
globostellata (Aurora),	...	cxxxvi, cxxxix, 187
globostellata (*Stelletta*),	...	187
globostellifera (*Geodia*),	...	261
globostelliferum (Cydonium),	...	205, 227, 261
globus (*Geodia*),	...	268
goliath (*Normania*),	...	92
gracilis (Sphinctrella),	xlii.	89, 90, 91
grandis (Tetilla),	v.	xvii, xxxix, xlvi, lxxxvii, cxxiii, cxxiv, 10, 14, 42
grandis, var. alba (Tetilla),	...	13
gravata (Tetilla),	...	46
grayi (Thenea),	vi.	65, 72
grubii (Stelletta),	...	186
haeckeli (Pilochrota),	xiv.	cxxxviii, 120, 132, 133
haldonensis (Monilites),		91
helleri (Papyrula),		199
helleri (*Stelletta*),	..	cxxxvi, 199, 200
Hemiasterella,		434
hemispherica (Trichostemma),	..	44
hemispherica (Polymastia),	...	444
heteroformis (*Coscinospongia*),		343
heteroformis (*Dactylocalyx*),		343
heteroformis (Heterophymia),		clv, 343
Heterophymia,		clv, 343
Heteroraphidæ,	...	416
Heterosclera,		416, 423
higginsi (Aciculites),	...	clvii, 347
hirsutus (Cydonium),	xxi.	xc, 218
Homasterina,	...	cxxxvii, 112, 179
Homoraphidæ,	...	415
Homosclera,	...	416, 422
Hoplophora,	...	cliii, 284, 326
horrida (Sphinctrella),	...	cxxxi, 89, 100
huxleyi (Amphius),	xlii.	cxii, cxlii, 178
Hymeniacidon,	...	cxxx
immunda (*Stelletta*),	...	189
imperfecta (*Geodia*),	...	269
imperfecta (Isops),	...	269
imperfecta (Neopelta),	...	345
implexa (Gastrophanella),	...	clviii, 349
inconspicua (*Pachymatisma*),	..	260
inconspicuum (Cydonium),	..	260
incrustans (Pœcillastra),	x.	105
individuosa (Ancorina),	..	204
inequalis (*Geodia*),	...	270
inequalis (Isops),	...	270
infrequens (Craniella),	...	53
ingalli (Tethya),	xliv.	xxii, 428, 431
innocens (Tethya ?),	...	439
innominatus (Acarnus),	...	lxxi
inscripta (Collinella),	...	cliv, 336
insidiosa (Craniella),	..	54
intermedia (Erylus),	...	241
intermedia (Placospongia),	...	272, 273
intermedia (*Stelletta*),	...	241
intermedia (Thenea),	vii.	97, 409
intexta (Microciona),	...	94
intexta (*Pachastrella*),	...	102
intextus (? *Samus*),	...	102
intextus (Triptolemus),	...	102
Isops,	...	xxxiii, cxlix, 236

	Plate	Page
japonica (Discodermia),	...	329
japonica (Tethya),	XLIV.	xci, 428, **430**
japonica (Tetilla),	...	xxxi, lxvi, cxxiii **46**
japonicum (Cydonium),	...	**256**
Jerea,	...	xxxii, 299, 300 335
Jereopsis,	...	299, 301, 334
johnstonia (*Halichondria*),	...	242
johnstonia (Pachymatisma),	XXXIV.	xxxvi, xl, xliii xlviii, cxliii, cxlviii **242**, 243
johnstoni (Vioa),	...	413
Kaliapsis,	...	cliv, 333
kittoni (*Corticium*),	...	275, 283
kittoni (Thrombus),	...	**283**
lactea (Pilochrota ?),	...	lxxxvii, **181**
lactea (*Stelletta*),	...	181
lævidiscus (Discodermia),	...	298, **329**
laminaris (*Normania*),	...	84
laminaris (Pœcillastra),	...	**84**, 86
Leodermatium,	...	clvii, 348
Leiodermatium,	...	clix, 352
lendenfeldi (Erylus),	...	**239**
lendenfeldi (Pilochrota),	VII.	**134**
lens (Craniella),	...	**54**
leptoderma (Tetilla),	L.	cxxiii, **3**, 45
Lithistida,	...	xxxix, cxv, 284 404
lithistina (Pachastrella ?),	...	**112**
lobularis (Oscarella),	...	xv, xxvi, clii, 40
longancora (Pilochrota),	XIV.	131
lutea (*Stellettinopsis*),	...	207
luteus (Coppatias),	...	**207**
Lyidium,	...	clvi, 343
lynceus (Leiodermatium),	...	clix, **352**
lyncurium, var. *contorta* (Tethya),	...	435
lyncurium, var. *nodulosa* (Tethya),	...	435
lyncurium (*Alcyonium*),	...	435
lyncurium, var. *obtusum* (Tethya),	...	435
lyncurium (Tethya),	XLIII. XLIV.	xli, xlii, xlviii, xci xcii, cxxi, 428 **435**
Macandrewia,	...	xi, lxxii, cxviii cxix, cxx, clv, 340
macandrewii (*Dactylocalyx*),	...	340
macandrewii (*Geodia*),	...	265
macandrewii (Synops),	...	**265**
macellata (Chrotella),	IV.	xxxv, xlvi, lxvi lxxxiii, lxxxvii cxxiii, cxxiv, cxxv **19**
madrepora (Amphibleptula),	...	clix, **351**
magellani (Cydonium),	XXI.	xlii, **221**
Magog,	...	442
mammillaris (Erylus),	...	cxliii, cxlvii, **238**
mammillaris (*Stelletta*),	...	cxxxv, cxxxvi, 238
mammilliformis (Anthastra),	...	**183**
mammilliformis (*Stelletta*),	...	183
marginata (Azorica),	XXXV.	307, **323**
marshall-halli (Raphidotheca),	...	lxxi, lxxxi, cxlvii
masoni (Corallistes),	XXXIV.	xlvi, xlviii, xc cxvii, 89, **303** 308
masoni (*Dactylocalyx*),	...	303
mastoideus (Erylus),	...	**240**
mastoideus (*Stelletta*),	...	240
maza (Tethya),	...	xvi, xc, xci, 428, **440**
media (*Geodia*),	...	266
media (Synops ?),	...	**266**
Megamastictora,	...	xcvi
megastrella (Geodia),	...	**248**
megastrella, var. lævispina (Geodia),	...	**248**
melobesioides (Placospongia),	...	cxliii, cl, **271**, 273
Meniscophora,	...	413, 416
merguiensis (*Tethya*),	...	14
merguiensis (Tetilla),	...	xl, lxxii, cxxiii clxi, **14**, 43, 205
Micromastictora,	...	xcvi
Microsclerophora,	...	cl, **274**, 279
microtuberculatus (Corallistes),	...	**339**
minima (*Clavellomorpha*),	...	69, 95
Monaxonida,	...	xxxvii
monilifer (Pachastrella),	...	cxxxiii, **110**
Monilites,	...	91
monolopha (Placina),	XLIII.	xv, xxvi, lxxxiii cli, **278**
Monotriæna,	...	cxlix, 253, 264 266, 268
moorei (Hymeniacidon),	...	412
morum (Tethya),	...	435
moseleyi (Pilochrota),	...	**133**
moseleyi (Scolopes),	XLIII.	**432**
mucronata (*Stelletta*),	...	193
mucronatus (Stryphnus),	...	192, **193**
mülleri (Craniella),	...	51
mülleri (Cydonium),	...	cxliii, cxlviii, **254**
multifida (*Donatia*),	...	441
multifida (Tethya),	...	**441**
muricata (*Tethea*),	...	95
muricata (Thenea),	VII.	xvii, xxxviii, xl xliv, li, xci cxxviii, cxxx cxlvii, 66, 69, 70 **95**, 97, 98, 99 288, 394, 408
murrayi (Psammastra),	XXXVIII.	xxxiii, xli, cxli clx, **175**
Myriastra,	...	xxii, xxxii, xli lxxxv, cvii, cxxxvi cxxxvii, cxxxviii cxlvii, 112, 114 389

	Plate	Page
nana (Nethea),	...	cxxxii, **103**
nana (*Tisiphonia*),	..	. . 103
NEOPELTA,	...	cxviii, clvi, 310 344
NEOSIPHONIA,	...	xxviii, cliv, 299 405
neptuni (Synops),	XXIV., XXV., XXVI.	xxxv, lxxxviii **227**, 257
NETHEA,	...	cxxxii, cxxxix, 103
niger (Dercitus),	...	. . 108
niger (Stryphnus),	XIX.	. xl, cxl, **171**, 193
nigrum (Ecionema),	...	. . 198
nitida (Synops),	XXI.	. . **231**
nodastrella (Geodia),	...	. . 247, 257
nodosa (Dædalopelta),	...	. . clv, **342**
noli-tangere (Corallistes),	..	. . 308, **339**
NORMANIA,	...	. cxxix, cxxx, 79
normani (Cydonium),	...	. . **263**
normani (Dragmastra),	XLIII.	xli, lxiii, cxi, cxxxix, **187**
normani (Pachymatisma),	...	. . **243**
normani (*Stelletta*),	...	. . 187
norvegica (Tethya),	...	. . 435
Nostoc,	...	. . 289
nucerium (*Discodermia*),	...	. 331
nucerium (Racodiscula),	...	. . **331**
nux (Cydonium),	...	. . **260**
nux (*Stelletta*),	...	. . 205, 260
nux (*Tethya*),	...	. . 260
obtectum (Setidium),	...	. . clviii, **350**
officinalis (Euspongia),	...	. . xl, 22
Ophiurids,	...	. . 23
ornata (Callipelta),	XXXVIII.	. . clv, **309**
ornata (Discodermia),	XXXI.	. . **297**
ornata (Sphinctrella),	XLII.	. . **90**
ornatus (Thrombus),	...	. . **283**
Oscillaria sp.,	...	. . 233, 289
osculosus (*Caminus*),	...	. . 242
ovata (*Emploca*),	...	. . xxviii, 287
ovata (Taxoploca),	...	. . xxviii
PACHASTRELLA,	...	lxxii, cxix, cxx cxxxi, cxxxiii cxxxiv, cxxxv, 104
Pachastrellidæ,	...	cxi, cxxxii, 16 104
pachastrelloides (*Ancorina*),	...	. . 205
pachastrelloides (Characella),	...	. . **409**
pachastrelloides (*Stelletta*),	...	. . 409
pachydermata (Isops),	...	. . xc, **236**
pachydermata (Pilochrota),	XXXVIII.	. xxii, xliii, **122**
PACHYMATISMA,	...	xxxix, lxxxvi, cvi cix, cxxxv, cxliii cxlv, cxlvi, cxlviii 242
packardi (Scleritoderma),	...	. clvii, 317, **346**
pallida (Isops),	...	. . 267
panicea (Halichondria),	...	. . lii, 208
paniceus (Tretolophus),	...	. . clviii, **325**
panoplia (Discodermia),	XXXII.	. . **295**
Panteosa,	...	cxlix, 245, 255, 265
papillata (Discodermia),	...	. . **329**
papillosa (*Plectronella*),	..	. . li
PAPYRULA,	...	cxxxvi, cxxxvii cxli, 198
parasitica (Arabescula),	...	. . **407**
parasitica (*Corallistes*),	...	. . 407
parasitica (*Geodia*),	...	. . 270
parasitica (Isops ?),	...	. . **270**
parasiticum (*Corticium*),	..	. . 282
parasiticus (*Pachastrella*),	...	. . 102
parasiticus (*Samus*),	...	. . 102
parasiticus (Triptolemus),	...	. . **102**
Parazoa,	...	. . xcv
parvispicula (Anthastra),	XIII., XL.	. . xliii, **145**
patelliformis (Xenospongia),	..	. . **443**
pathologica (Stelletta),	..	. cxxxvi, **202**
paupera (Geodia),	...	. . **252**
pedifera (Tetilla),	XLI.	xv, xvii, xlvi, cxxiv cxxvi, **6**, 9, 149
perarmata (Geodia),	...	. . **245**
perfecta (Neopelta),	...	. . clvi, **344**
pergamentacea (*Geodia*),	...	. . 262
pergamentaceum (Cydonium),	...	. . **262**
PETROSIA,	...	. . xxviii
pfeifferæ (Azorica),	XXXVI.	xxi, xc, cxvii, clviii 127, **319**, 404, 405
PHAKELLIA,	..	. . 420
phlegræi (Isops),	...	. . cxlix, **267**
phrissens (Stelletta),	XVI.	xvii, xix, xxiii xxvii, xxxi, xci cxlvii, **150**
Pilochrota,	...	xxii, xli, lxxxv lxxxvii, cxxxvi cxxxvii, cxxxviii 120
pilosa (*Spongia*),	...	. . 51
placenta (Geodia),	..	. . **248**
placentula (Hymeniacidon),	...	. . cxxx, 98
PLACINA,	..	xi, xv, xxvii, xxxvi lxvii, lxviii, lxxviii lxxxiii, lxxxvii cviii, cl, 278, 419
PLACINASTRELLA,	...	lxxii, lxxxiv, cxxxii, cxxxiv, 103 421
Placinidæ,	...	. cxiii, cl, 278
PLACORTIS,	..	cli. 279, 404, 419
Placospongidæ,	...	. . 271
PLACOSPONGIA,	...	i, lxvii, cxxi, cxliii cxliv, cl, 271
pleiades (Cydonium),	..	. . **257**
plena (Plocamia),	...	. . lxvii
PLEROMA,	...	cxviii, cxx, clvi 312
Pleromidæ,	...	. clvi, 312, 343
plicata (Calcabrina),	...	. . cli, **281**
plicatum (*Corticium*),	...	. . 281

	Plate	Page
pluristellatum (Cnemidiastrum),	..	348
poculum (Gelliodes),	...	172
Pœcillastra,	...	xxvii, liii, lxxii, lxxxiv, lxxxvii, cix, cx, cxi, cxxvii, cxxix, cxxx, cxxxii, cxxxiii, cxxxiv, 16, **79**, 92
Polycricos [Infusorian],	...	xciv
polydiscus (*Corallistes*),	...	327, 332
polydiscus (*Dactylocalyx*),	...	330
polydiscus (Discodermia),	...	cxv, cliii, **330**, 332
polydiscus (Racodiscula),	...	cliii, **332**
polyura (Tetilla),	...	3, **47**, 53
ponderosa (*Ecionema*),	...	cxxxvi, 193
ponderosus (Stryphnus),	...	cxxxvi, **193**
Portella,	...	clviii, 351
pratti (*Dactylocalyx*),	...	326
pratti (Theonella),	...	**326**
primum (*Alcyonium*),	...	242
profunditatis (Stelletta),	...	**203**
Protelela,	...	lxxxvi
Psammastra,	...	cxxxvi, cxxxvii, cxli, 174
pulcher (Astropeplus),	x.	lxxxviii, **422**
pulchra (Anthastra),	xii.	cxxxviii, **138**, 144
pulchra (Craniella),	...	**37**
pumex (Astrella),	...	**182**
pumex (*Stelletta*),	...	182
pumiceus (Dactylocalyx),	..	cxv
purpurea (Pilochrota),	..	**409**
purpurea, var. longancora (Pilochrota),	...	**131**, 133
purpurea, var. parvistella (Pilochrota),	...	**410**
purpurea (*Stelletta*),	...	131, 409
purpurea, var. parvistella (*Stelletta*),	...	410
purpurea, var. *retroflexa* (*Stelletta*),	..	409
purpurea (*Stellettinopsis*),	...	207
purpureus (Coppatias),	...	**207**
pygmæorum (Ecionema ?),	...	**203**
pygmæorum (*Stelletta*),	...	203
pyriformis (Anthastra),	xv.	lxxxix, xc, **146**, 176
pyriformis (*Ecionema*),	...	146
pyriformis (Synops),	...	cxlix, 235, **266**
Pyxitis,	...	cxlviii
quadrata (Myriastra),	...	118
quadripartita (*Samus*),	...	93
quadriradiata (*Microciona*),	..	420
quadriradiata (Tricentrium),	...	420
quinqueradiata (*Microciona*),	...	420
quinqueradiata (Tricentrium),	...	420
Racodiscula,	...	cliii, 295, 331
radiata (*Agilardiella*),	...	xxx, 163, 165, 190
radiata (Siphonia),	...	287
radiata (Tethyopsis),	...	**190**
radiata (Tetilla),	...	xxxi, **48**
ramodigitata (Geodia ?),	...	**253**
ramosum (*Leiodermatium*),	...	348
ramosum (Siphonidium),	..	xlviii, cvi, clvii, 318, **348**
repens (Tethya),	...	**439**
reticulata (Aurora),	...	**188**
reticulata (Geodia),	...	**253**
reticulata (*Stelletta*),	...	cxxxvi, 188
Rhabdasterina,	...	174, 195
Rhabdosa,	...	315, 344
Rhachella,	..	clii, 281
Rhagadinia,	..	295
ridleyi (Anthastra),	...	**196**
ridleyi (Tetilla),	...	**48**
Rimella,	...	cliv, 335
robusta (Tethea),	..	431
robusta (Tetilla),	..	**48**
rosea (Dendrilla),	..	xxxvi
rotundum (Ecionema),	..	**198**
rudis (Stryphnus),	..	**194**
sacciformis (*Chondrilla*),	...	412, 442
sacciformis (Magog),	..	**442**
Samidæ,	...	57
Samus,	...	cxxvi, cxxxi, 57
sandalina (Tetilla),	I.	xxxii, cxxiii, clx, **1**, 5, 47
Sanidasterina,	...	153, 188
sarniensis (*Collingsia*),	...	185
scabra (Pœcillastra),	...	**99**
scabra (*Stelletta*),	..	99
sceptrellifera (*Discodermia*),	...	333
sceptrellifera (Racodiscula),	...	**333**
schmidtii (*Collingsia*),	...	185
schmidtii (Craniella),	XLII.	lxxxi, xci, cxxiv, **38**
schmidtii (Neosiphonia),	...	**334**
schmidtii (*Pomelia*),	...	332
schmidtii (*Tethea*),	...	185
schmidtii (Thenea),	VII., VIII.	xci, 65, **67**
schmidtii (*Tribrachion*),	...	154
schmidtii (Tribrachium),	XVII., XLI.	xxv, xxxiv, lxxxv, cxxxix, **154**, 166, 168, 404
schœnus (Radiella),	...	lxxi
schulzii (*Normania*),	...	79
schulzii (Pœcillastra),	IX.	xli, lxix, **79**, 83, 85, 425
Scleritoderma,	...	cxviii, cxx, clvii, 315, 346
Scleritodermidæ,	...	clvii, 315, 346
Scolopes,	...	432
Scolopidæ,	...	418, 432
Setidium,	...	clviii, 350
seychellensis (*Alemo*),	...	427
seychellensis (Tethya),	XLIV.	xxii, xlvi, xci, **427**, 432, 440, 441
sferica (*Tetie*),	...	435

	Plate	Page
Sigmatophora,	..	cx, cxxi, 1
sigmatophora (*Ancorina*),	...	205
simillima (Craniella),	II., V., XL.	xxiv, xl, xci, cxxiv **30**, 40, 54, 55
simillima (*Tethea*),	..	30
simplex (Asteropus),	...	cxlii, **205**
simplex (Calthropella),	X.	cxxxiii, **107**, 111
simplex (Chrotella),	II.	xix, lxxxvii, cxxiii cxxv, **17**
simplex (Cydonium),	..	**264**
simplex (*Geodia*),	...	264
simplex (Placortis),	...	cli, **279**, 419, 422
simplex (*Samus*),	..	102
simplex (*Stellettinopsis*),	..	205
simplex (Stœba),	...	cxxxi, **102**
simplicifurca (Myriastra),	XII.	**114**
simplicissima (*Ancorina*),	..	179
simplicissima (Myriastra),	..	**179**
simulans (Halichondria),	..	xciii
sinuosa (Discodermia),	..	**330**
SIPHONIA,	..	xi, xxviii, xxx xxxii, cxviii, 299 300, 405
SIPHONIDIUM,	..	clvii, 317, 348
sollasi (Proteleia),	...	lxxi, lxxxvi, 259
sphæroconia (Caminus),	XXVII.	xxvii, xxxiii, xlvi lxii, **214**
sphæroides (Isops),	..	268
sp. (Geodia),	...	lxxxvii
sp. Thenea),	VIII.	77, 78
sp. (Tetilla),	..	16
spherica (Tethya),	..	435
SPHINCTRELLA,	...	cix, cx, cxxxi cxxxiv, cxxxv, **87** 89
spiculitesta (Rotalia),	..	lxxiv
spinatostellifera (Hymeniacidon),	..	412
Spintharophora,	...	413, 416, 419, 421
spinispirulifera (*Discodermia*),	...	333
spinispirulifera (Racodiscula),	..	**333**
Spiraspinthara,	..	418, 432
Spirastrellidæ,	...	419
spongeliæ (Oscillaria) [Alga],	...	118
Spongiæ,	...	xcv
Spongilla,	...	xvi, xlv
SPONGODISCUS,	...	337
squamata (Columnitis),	...	441
stalactites (Vetulina),	...	xlviii, xc, **354**
stellata (*Cometella*),	...	440
stellata (Hymedesmia),	...	412
stellata (Tethya),	...	**440**
stellatum (Cnemidium),	...	348
STELLETTA,	...	xvi, xxiv, xxvii, xlv lxx, cxxvii, cxxxiv cxxxv, cxxxvii cxxxix, 150
Stellettidæ,	...	cxii, cxxxiv, 112, 404
STELLETTINOPSIS,	...	cxlii, 201
stellettodes (Characella),	...	**101**
stellettodes (*Pachastrella*),	..	101
stellifera (*Amorphina*),	..	208
stellifera (Coppatias),	...	**208**
stellifera (*Stellettinopsis*),	...	208
stelligera (Corticella),	..	clii, **281**
stelligera (Raspalia),	..	412
stelligerum (*Corticium*),	..	281
stelligerus (Suberites),	..	412, 414
stellivarians (Hymedesmia),	..	412
stellosa (Geodia ?),	..	**410**
stellosa (*Isops*),	..	410
Sterrastrosa,	..	209
stipitata (*Tethya*),	..	49
stipitata (Tetilla ?),	..	lxvi, cx, cxxiii **49**, 59
STŒBA,	..	cxxxi, cxxxiv, **102**
Streptastrosa,	..	59
STRYPHNUS,	..	xl, cix, cx, cxxxvi cxxxvii, cxl, cxli 171, 409
stuposus (Dictyocylindrus),	..	412, 420
suberea (Suberites),	..	xlviii
Suberitidæ,	..	xxxvii, 418
submersa (Fangophilina),	...	**55**
subtilis (Myriastra),	XIV.	cxxxviii, **113**
SULCASTRELLA,	..	cliv, 337
superstes (Neosiphonia),	XXXI.	xxviii, xxxii, cliv **299**
superstes (Cystispongia),	...	398
swinhoei (Theonella),	XXIX., XXX.	xxxii, xlviii, xc cxvii, cliii, **284** 326
SYMPYLA,	...	353
SYNOPS,	...	cxlix, 227, 265
TAXOPLOCA,	..	xxviii
tenuilaminaris (*Normania*),	...	85
tenuilaminaris (Pœcillastra),	V.	**85**
tenuispicula (Pilochrota),	XV.	**127**
ternatus (Acarnus),	...	lxxi
TETHYA,	...	xxii, xci, cxxi cxliv, 427
Tethyidæ,	..	xxxvii, 417, 427, 435
tethyoides (Craniella),	..	**54**
TETHYOPSIS,	..	cxxxvi, cxxxvii cxl, cxli, 189
tethyopsis (Anthastra ?),	...	149, **203**
tethyopsis (Myriastra ?),	...	203
tethyopsis (*Stelletta*),	...	149, 203
TETILLA,	...	xi, xv, xxiii, xxxi xxxvi, xlv, lxvi lxxxv, cviii, cix cxxiii, cxxiv, cxxxv 1, 16, 50, 421
Tetillidæ,	...	1, 56, 404
Tetillidæ, Tabular view of,	...	56
Tetracladidæ,	...	cliii, 284, 326

	Plate	Page
Tetractinellida,	...	xxxvii, 1
Tetradina,	...	cl
Thenea,	...	xv, xvi, xxix, xxxii xxxviii, xxxix lxvii, lxviii, lxix lxx, lxxii, lxxxiv lxxxv, lxxxvi, xci cviii, cx, cxii cxxviii, cxxxii cxxxiv, 59, 381 404, 405
Theneidæ,	...	cx, cxxvii, 59 404
Theonella,	...	cxviii, cliii, 284
thomasi (Coralliistes),	xv., xxxv.	307
thompsoni (Geodia),	...	254
Thoosa,	...	cxxvi
Thrombidæ,	...	cxiii, clii, 274
Thrombus,	...	xxi, clii, 275
Tisiphonia,	...	cxxviii, 95
torquila (Lyidium),	...	clvi, 343
toxodonta (Myriastra),	xiv.	119
Trachya,	...	433
transiens (Erylus),	...	241
transiens (*Stelletta*),	...	241
Tremaulidium,	...	clix, 352
Trefolophus,	...	clviii, 325
Triacnosa,	...	cliii, 284, 326
Triate,	...	cxliii, cxlvii
Tribrachium,	...	cxxxvi, cxxxvii cxxxix, cxli, 153
Tricentrium,	...	417
trigonostellata (Hymeniacidon),	...	412
trilopha (Placina),	...	lxxii, lxxxiii, cviii cxiii, 277, 279
tripodaria (Ancorina?),	...	203
Triptolemus,	...	cxi, cxxxi, cxxxiv 93
tuberculata (*Stellettinopsis*),		207
tuberculatus (Coppatias),	...	207
tuberculosa (Geodia),	...	251
tuberosa (*Geodia*),	...	263
tuberosum (Cydonium),	...	263
tumulosa (Geodia),	...	249
turbinatum (Pleroma),	xxxiii.	cxvii, clvi, 312
typa (Petrosia),	...	xxviii
typa (*Siphonia*),	...	xxviii
typus (Corallistes),	xxxiv.	cxvii, clv, 301 308, 30
typus (Hemiasterella),	...	434
unca (*Tethya*),	...	51, 52
unguiculus (Stryphnus),	xv.	195
vermicularis (Discodermia),	...	331
verruca (Ancorina),	...	188
Verrucina,	...	cxviii
verrucosa (Corallistes),	...	339
verrucosa (*Spongia*),	...	435
versatile (Corticium),	...	280
Vetulina,	...	cxvii, cxxi, clix
vickersii (*Dictyocylindrus*),	...	420
vickersii (Tricentrium),	...	420
violacea (Aplysilla),	...	xxxvii
virgultosa (Suberites),	...	414
vosmaeri (Astrella),	xvi.	cxxxviii, 136
vosmaeri (Synops),	xxiii., xl.	xxvii, 234
Vulcanella,	...	cxxxi, 87, 89
vulcani (Caminus),	...	cxliii, cxlviii, 218 241
wageneri (Ancorina),	...	189
wageneri (*Stelletta*),	...	189
wallichii (Thenea),	...	62, 82, 95, 288
wallichii (*Wyville-Thomsonia*),	...	95
wrightii (Thenea),	viii.	63, 78
wyvillii (Thenea),	vi.	xxxiii, lxxxv lxxxviii, 61, 71 74, 78
Wyville-Thomsonia,	...	cxxviii
Xenospongia,	...	443
zetlandica (Craniella),	...	cix, 55
zetlandica (*Geodia*),	...	254
zetlandica (*Tethya*),	...	55
zetlandicum (Cydonium),	...	254

INDEX TO AUTHORS.

Agassiz, ii, 299, 318, 332, 333, 335, 351.
Balfour, xcii.
Barrois, xciv.
Berry, Capt., 256.
Blainville, 51, 435.
Bocage, cliii, cxv, 292, 330.
Bowerbank, ii, lii, lv, lxviii, xci, cxv, cxxviii, cxxix, cxxx, cxxxiii, cxl, cxlviii, cliv, clv, 31, 51, 57, 79, 95, 98, 184, 185, 193, 195, 196, 197, 242, 243, 244, 245, 249, 250, 251, 252, 253, 258, 260, 265, 266, 269, 270, 271, 272, 303, 308, 326, 330, 333, 334, 340, 343, 412, 417, 431, 435.
Bütschli, xcii, xciii.
Carter, iii, xvi, xxxi, xxxvi, xxxvii, xlv, lii, lviii, lxii, lxvi, lxxiv, lxxxv, xcii, xciii, cix, cxi, cxvi, cxxi, cxxii, cxxvi, cxxvii, cxxviii, cxxx, cxxxi, cxxxii, cxxxiv, cxxxv, cxxxvi, cxliii, cxliv, cxlix, clii, clviii, 14, 42, 43, 44, 48, 49, 50, 51, 53, 55, 57, 69, 91, 93, 95, 98, 99, 100, 102, 103, 104, 108, 111, 142, 179, 181, 183, 186, 187, 188, 193, 196, 197, 200, 203, 205, 207, 208, 239, 242, 246, 247, 248, 253, 254, 260, 261, 262, 271, 275, 281, 282, 283, 298, 301, 303, 308, 319, 326, 327, 330, 333, 334, 338, 339, 340, 341, 348, 349, 352, 405, 407, 409, 412, 414, 420, 431, 434, 435, 441, 442, 443.
Clark, James, xxxvi, xcii.
Cookson, W. E., 256.
Czerniavsky, 410.
Dendy, i, l, lxvii, lxxi, lxxxvi, cxiv, cxlvii, 411, 413, 414, 415, 416, 417, 418, 419, 420.
Deszö, xci, 435.
Döderlein, 295, 298, 327, 329, 331, 349.
Dohrn, Anton, xcii.
Donati, 242, 435.
Duchassaing and Michelotti, cxv, 244.
Fewkes, 410.
Fleming, cxlviii, 51, 254, 435.
Forbes, Edward, 382.
Fitzgerald, George, lxxv.
Flower, iii.
Ganin, xcii.
Graaf, von, ii, 238, 239, 248, 263.
Gray, xcv, cxv, cxxi, cxxii, cxxvi, cxxviii, cxxxiii, cxliii, cxliv, cxlvii, cl, cliii, clv, 51, 57, 95, 108, 185, 209, 237, 238, 250, 254, 271, 284, 340, 434, 443.
Grube, 242.
Günther, iii.
Haddon, iii, 259, 390.
Haeckel, xiii, xxvii, xxxvii, lxxiv, xcii, xcvi, 95, 326.
Hall, James, 399.
Hansen, 51, 53, 69, 95, 242.
Heider, xiii, xcii, xciv.
Hoyle, 390.
Hunt, A. R., 393.
Hyatt, 46.
Jameson, 254.
Johnson, 308.
Johnston, 51, 242, 254, 435.
Keller, xiii, 409.
Kent, Saville, xcii, xciv, cxxviii, 95, 185, 238.
Koehler, 242.
Kölliker, 280.
Lamarck, cxliii, cxlviii, 51, 244, 249, 435.
Lamouroux, 51, 435.
Lampe, xxxi, 46.
Lendenfeld, R. von, xxxv, xxxvi, xxxvii, xliii, l, li, lx, xcii, xciii, xcvi, 49.
Leuckart, xcii.
Lieberkühn, xvi, xlv.
Linnæus, 435.
Marenzeller, 46, 95.
Marshall, xxiii, xxx, xcii, cxxi, 163, 165, 190.
Merejkowsky, xci.
Metschnikoff, xxxi.
Montague, 51, 435.
Moseley, 400.

Müller, cxxi, 51, 218, 254.
Murray, ii, 411.
Nægeli, cvi.
Nardo, 435.
Norman, cxxx, 50, 51, 53, 55, 95, 98, 108, 181, 187, 194, 243, 254, 259, 264, 266, 435.
Pallas, 435.
Perrier, ii, 101, 110, 180, 193, 202.
Peysonnel, xxxv.
Poléjaeff, xlv, xcii, xcv, cvi, 125.
Pomel, clv, 343.
Quensted, 287.
Ridley, i, ii, l, lxxi, lxxxvi, cxiv, cxlvii, 48, 116, 161, 165, 198, 205, 208, 211, 240, 260, 261, 272, 407, 409, 410, 411, 413, 416, 417, 418, 419, 420, 431.
Schmidt, O., xlv, lxxii, xc, cxv, cxvii, cxviii, cxxii, cxxiv, cxxvi, cxxxi, cxxxiii, cxxxv, cxxxix, cxli, cxliii, cxlviii, cli, clii, cliv, clv, clvi, clvii, clviii, clix, 3, 26, 39, 45, 47, 51, 54, 55, 67, 71, 73, 87, 95, 99, 100, 101, 104, 108, 110, 111, 112, 150, 179, 180, 181, 182, 186, 188, 189, 192, 193, 198, 199, 202, 203, 204, 205, 206, 214, 237, 240, 241, 242, 248, 254, 258, 262, 263, 264, 265, 268, 271, 274, 280, 281, 299, 301, 308, 315, 317, 319, 328, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 398, 408, 412, 435, 438, 439, 440, 441.
Schulze, F. E., xiii, xiv, xxi, xxxvi, xxxviii, xl, xlvii, li, lxv, xci, xcii, cxiv, cxxxii, cl, cli, clxii, 22, 103, 118, 278, 279, 280, 381, 398, 399, 401, 408, 428, 441.
Selenka, xvi, xxxi, xci, 45, 48, 205, 260, 440.
Semon, R., lxxv.
Städeler, xlvii.
Stewart, C., ii, xliii, li, lxxv, cxl, 189, 190.
Stewart, T. H., xci.
Théel, Hjalmar, lxxv.
Thomas, T. H., iii.
Thomson, Wyville, cviii, cxv, cxxviii, 71, 95.
Thoulèt, xlvii.
Verrill, A. C., 46.
Vosmaer, xxi, xxiii, xliii, l, liii, lv, lviii, xci, xciii, xcv, xcvi, cviii, cxxviii, cxxxv, cxliii, cxlix, cli, clii, clvi, clvii, 3, 47, 51, 69, 73, 95, 97, 192, 205, 227, 250, 254, 260, 266, 267, 268, 279, 348, 399, 400, 410, 411, 414, 419, 427, 435, 444.
Weltner, cxxxix, 153, 204, 241, 404.
Whidborne, G. F., 400.
Whiteaves, 95, 99.
Woodward, 382.
Wright, E. Perceval, xci, cxxviii, 95, 205, 261, 382, 394, 427, 440.
Ziegler, ii, 180, 205.
Zittel, cxvi, clii, cliii, cliv, clv, clvi, clvii, clviii, clix, 189, 284, 295, 301, 303, 308, 310, 319, 326, 327, 330, 331, 332, 334, 338, 339, 341, 343, 344, 348, 352, 354, 399, 407.

PLATE I.

PLATE I.

PAGE

Figs. 1–15. *Tetilla leptoderma*, . . . 3

Figure 1. Sponge; nat. size.

„ 2–11. Spicules—

Fig. 2. Oxea of the radial spicular fibres; × 20.
„ 3. Protriæne; × 20.
„ 4. Somal anatriæne; × 20.
„ 5. Oxea, not forming spicular fibre; × 20.
„ 6. Radical anatriæne; × 180.
Fig. 7. Somal anatriæne; × 125.
„ 8. Sigmaspires; × 290.
„ 9. Cladome of protriæne; × 180.
„ 10, 11. Trichodal protriænes, parts of; × 290.

„ 12. Transverse section taken through a pore-sieve, and the adjacent tissues; × 125.

„ 13. Section through part of the choanosome; × 125.

„ 14. Transverse section of a part of the sponge; × 11.

„ 15. A part of the preceding; × 34.

Figs. 16–27. *Tetilla sandalina*, . . . 1

„ 16. Sponge; nat. size.

„ 17. Two flagellated chambers; × 300.

„ 18. A vertical longitudinal section through the sponge; × 4·5.

„ 19. Choanocytes; × 430.

„ 20–25. Spicules—

Fig. 20. Oxea; × 50.
„ 21. Protriæne; × 50.
„ 22. Sigmaspires; × 360.
„ 23–25. The cladome of the protriæne and its modifications; fig. 23, heterocladal protriæne; fig. 24, heterocladal prodiæne; fig. 25, promonæne; × 180.

„ 26. Section of a part of the choanosome; × 180.

„ 27. Section of a part of the ectosome, showing flagellated chambers situated immediately beneath the outer skin; × 180.

Figs. 28–35. *Craniella carteri*, . . . 35

„ 28. Sponge; nat. size.

„ 29–33. Spicules—

Fig. 29. Somal oxea; × 41.
„ 30. Anatriæne; × 40.
„ 31. Protriæne; × 40.
Fig. 32. Cladome of protriæne; × 180.
„ 33. Cladome of anatriæne; × 180.

„ 34. Transverse section through the cortex and adjacent choanosome; × 15.

„ 35. Part of the preceding more highly magnified, showing one of the dermal glands; × 290.

T.H.Thomas del.

W.J.Sollas dir.

F.Huth, Lith^r Edin^r

Figs 1-15, TETILLA LEPTODERMA. Figs 16-27, TETILLA SANDALINA.
Figs 28-35, CRANIELLA CARTERI.

PLATE II.

PLATE II.

PAGE

Figs. 1–4. *Chrotella simplex*, . . . 17

Figure 1. Radial section through the cortex and adjacent choanosome; × 90.

„ 2. The same, less highly magnified; × 22.

„ 3, 4. Spicules—

Fig. 3. Protriæne; × 125. | Fig. 4. Anatriæne; × 125.

Figs. 5–20. *Craniella simillima*, . . . 30

„ 5. Sponge; nat. size.

„ 6–10. Spicules—

Fig. 6. Oxea of the radial spicular fibres; × 73.
„ 7. Protriæne; × 73.
„ 8. Cladal end of a protriæne; × 180.
Fig. 9. Cladal end of an anatriæne; × 180.
„ 10. Cladal end of an anatriæne; × 180.

„ 11. A second example of the sponge; nat. size.

„ 12. Transverse section through the cortex; × 15.

„ 13. Transverse section through the cortex and adjacent choanosome; × 15.

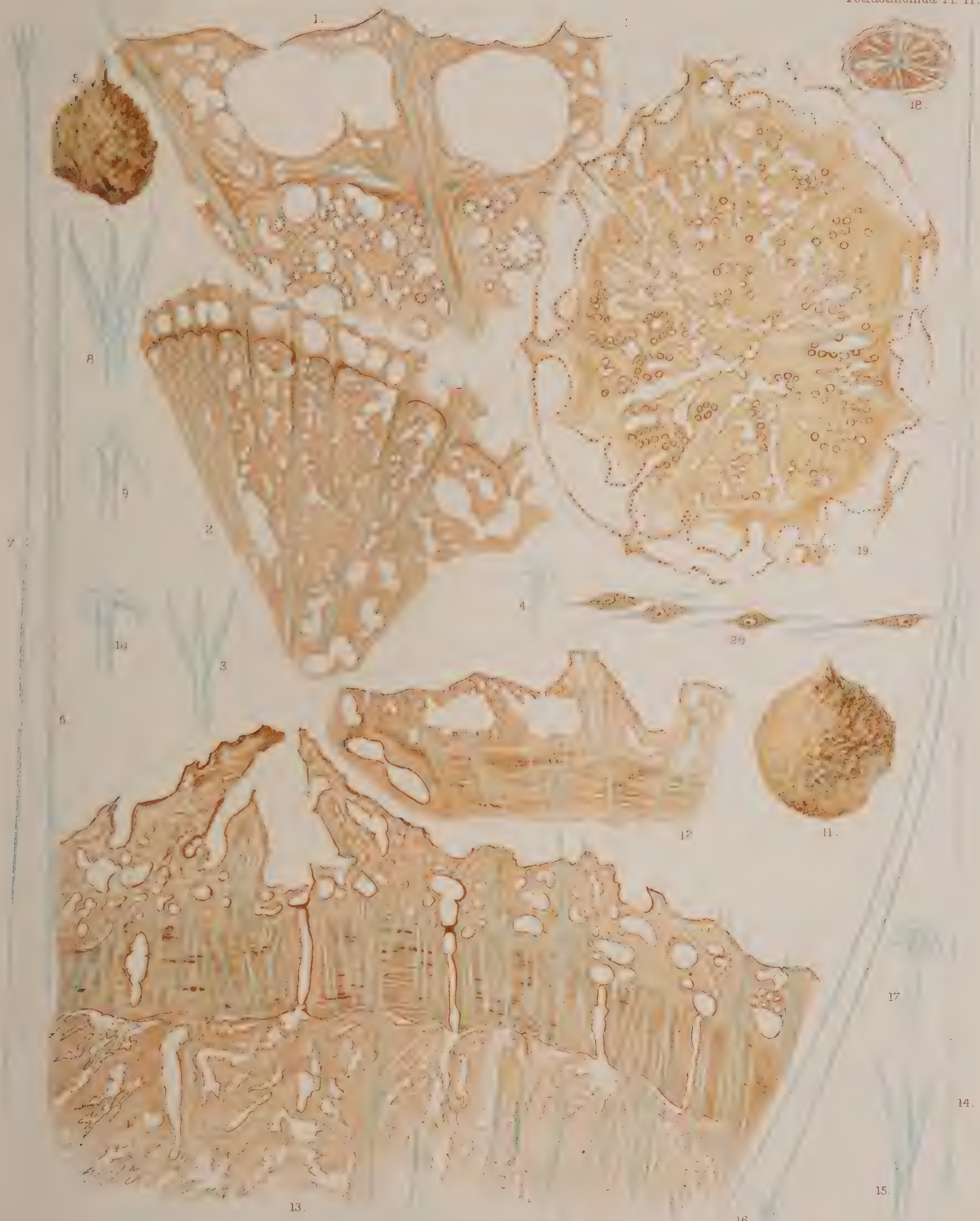
„ 14–17. Spicules—

Fig. 14. Protriæne; × 73.
„ 15. Cladal end of protriæne; × 180.
Fig. 16. Anatriæne; × 73.
„ 17. Cladal end of anatriæne; × 180.

„ 18. Section through one of the young sponges found within the body of the parent; × 10.

„ 19. The same more highly magnified; × 49.

„ 20. Parts of the rhabdomes of protriænes from a young sponge, showing the scleroblasts; × 430.



T.H.Thomas del.

W.J.Sollas dir.

M^cFarlane & Erskine, Lith^rs, Edin^r

Figs 1–4, CHROTELLA SIMPLEX. 5–20, CRANIELLA SIMILLIMA.

PLATE III.

PLATE III.

PAGE

Cinachyra barbata, ... 23

Figure 1. Sponge; nat. size. The lower moiety is the basal mass of anchoring spicules.

„ 2, 3. Young sponges, showing the development of the basal mass; nat. size.

„ 4–8. Spicules—

Fig. 4. Anisoactinate oxea, esactine pointing upwards; × 16.
„ 5. Anatriæne; × 16.
Fig. 6. Protriæne; × 16.
„ 7. Cortical oxea; × 16.
„ 8. Sigmaspires; × 220.

„ 9. Horizontal section through a young sponge.

„ 10. Transverse section through the cortex and adjacent choanosome; × 20.

„ 11. Transverse section through the cortex; × 73.

„ 12. Transverse section through the outer one-fourth of the cortex; × 292.

„ 13. Section through the choanosome, showing the eurypylous chambers; × 180.

„ 14, 15. Tangential sections through the vestibule and cloaca, showing granule cells and fusiform cells in the collenchyma, some of the fusiform cells directed at right angles to the epithelium; fig. 14 × 360, fig. 15 × 540.

T.H Thomas del.

W.J. Sollas dir

F Huth, Lith^r Edin^r

CINOCHYRA BARBATA.

PLATE IV.

PLATE IV.

PAGE

Figs. 1–22. *Chrotella macellata*, . . 19–23

Figure 1. Sponge; nat. size.

„ 2. Transverse section through the sponge; nat. size.

„ 3–15. Spicules—

Fig. 3. Somal oxea of the spicular fibres; × 22.
„ 4. Promonæne; × 22.
„ 5. Prodiæne; × 22.
„ 6. Trichodal protriæne; × 292.
„ 7. Trichodal prodiæne; × 292.
„ 8. Cladal end of the protriæne; × 180.
„ 9. Anatriæne; × 17.

Fig. 10. Somal oxea of the spicular interspaces; × 22.
„ 11, 12. Toxaspires of the cortex; × 292.
„ 13. Cladal end of an anatriæne; × 180.
„ 14. Cladal end of a cortical protriæne; × 180.
„ 15. Cladal end of a hispidating protriæne; × 180.

„ 16. Longitudinal section through the wall of the cloaca; × 34.

„ 17. Radial section through the sponge, showing the cortex and choanosome; × 18.

„ 18. A part of the preceding more highly magnified; × 49.

„ 19. Section through the lining membrane of the cloaca; × 292.

„ 20. Section through a part of the choanosome, showing the aphodal flagellated chambers; × 200.

„ 21. Section through an ovum; × 292.

„ 22. Section through an ovum with pseudopodia-like extensions; × 125.

Figs. 23–31. *Craniella simillima*,[1] . . . 30

„ 23. Sponge; nat. size.

„ 24–29. Spicules—

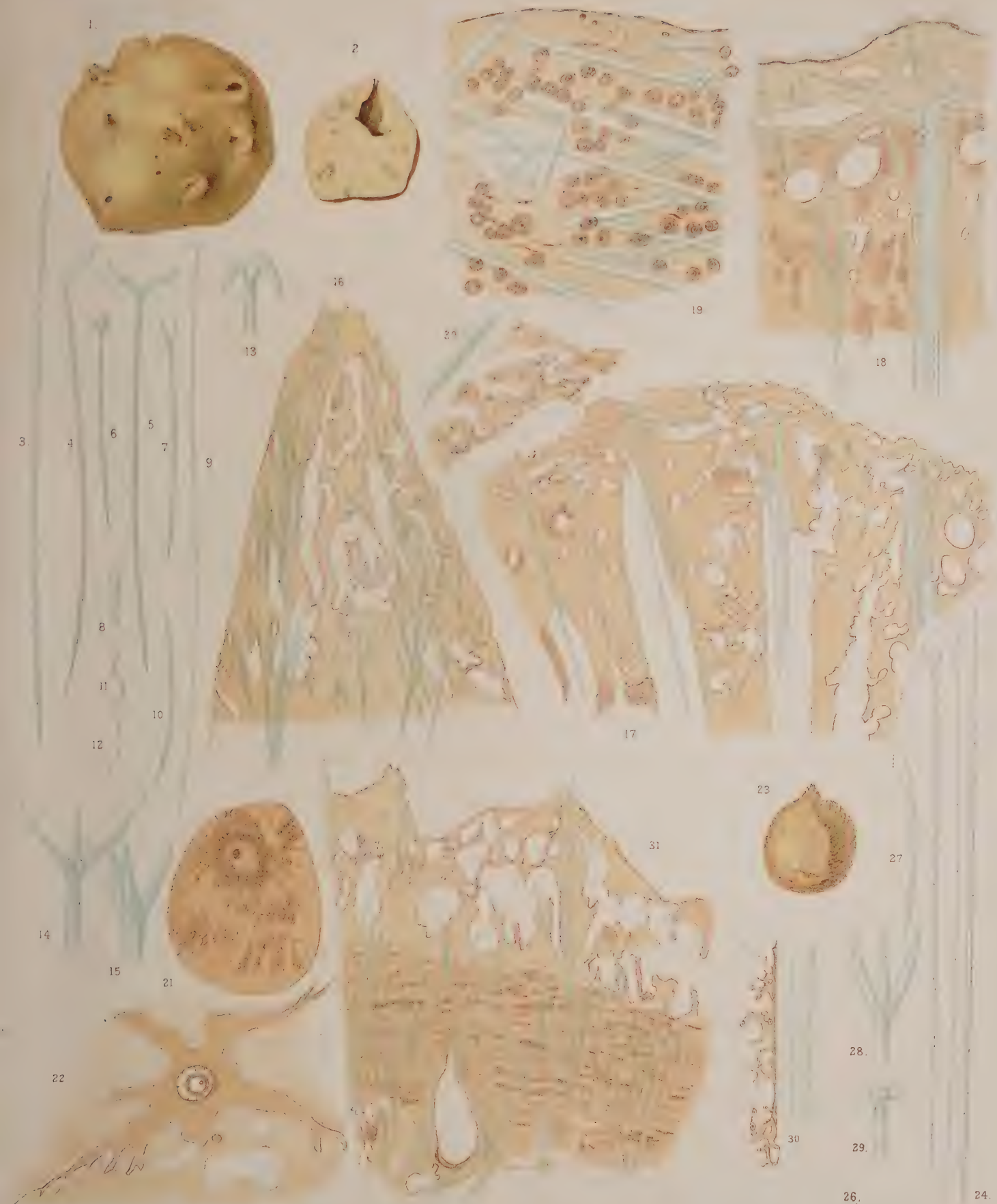
Fig. 24. Somal oxea; × 73.
„ 25. Anatriæne; × 73.
„ 26. Protriæne; × 73.
„ 27. Cortical oxea; × 73.

Fig. 28. Cladal end of protriæne; × 180.
„ 29. Cladal end of anatriæne; × 180.

„ 30. Part of a series of cells frequently found on the sides of the megascleres; × 180.

„ 31. Transverse section through a part of the cortex; × 34.

[1] The specific name *bowerbankii* has been abandoned since the Plate was printed off.



T.H. Thomas del

W.J. Sollas dir.

F. Huth, Lith.r Edin.r

Figs 1-22, CHROTELLA MACELLATA. Figs 23-31, CRANIELLA BOWERBANKII.

PLATE V.

PLATE V.

PAGE

Figs. 1–14. *Tetilla grandis*, ... 10

Figure 1. Sponge, with basal mass of spicules; nat. size.

„ 2. Young sponge, without a basal mass; nat. size.

„ 3. *Tetilla grandis*, var. *alba*, sponge; nat. size.

„ 4. Section through a young specimen; × 9·5.

„ 5. Radial section through the cortex of the adult sponge, showing the cavernous vesicular tissue; × 292.

„ 6*a*. Section through a part of the cortex, showing the cladal end of an anatriæne, with the nuclei of associated cells forming a series along its sides; × 292.

„ 6–14. Spicules—

Fig. 6. The cladal end of a normal anatriæne; × 180.

„ 7. The cladal end of a young form of anatriæne; × 292.

„ 8. The cladal end of an anatriæne, in which the rhabdome is continued distally past the cladal origin; × 292.

„ 9. The cladal end of an anadiæne presenting the same feature; × 292.

Fig. 10. The cladal end of a young prodiæne, showing the tylus; × 292.

„ 11. The cladal end of a young form of protriæne.

„ 12. The cladal end of a protriæne, in which the cladi show a tendency to branch; × 292.

„ 13. The end of a rhabdus, with an accessory cladus; × 292.

„ 14. The end of a rhabdus with several accidental branches.

Fig. 15. *Craniella simillima*, ... 30

„ 15. The cladal end of a young triæne, before the appearance of cladi, showing the tylus; × 576.

Fig. 16. *Craniella cranium*, ... 51

„ 16. The cladal end of an anatriæne, in which a second cladome has developed; × 292.

Figs. 17, 18, *Pœcillastra tenuilaminaris*, . . 85

„ 17. Sponge; nat. size.

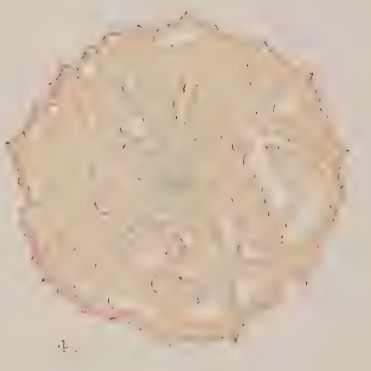
„ 18. Longitudinal transverse section, showing the thickness of the wall; nat. size.

1.

18 17

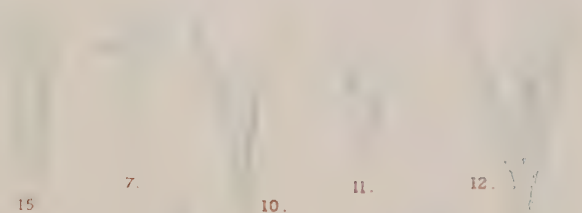
2.

3.



4.

5.



15 7. 10. 11. 12.

6. 8. 9. 16. 13. 14.

Figs 1-14, TETILLA GRANDIS. Fig. 15, CRANIELLA SIMILLIMA. Fig. 16, CRANIELLA CRANIUM.
Figs 17-18, POECILLASTRA TENUILAMINARIS.

PLATE VI.

PLATE VI.

PAGE

Figs. 1–9. *Thenea wyvillii*, ... 74

Figure 1. Sponge; nat. size.

,, 2. The "pileus," seen from above, showing the characters of the oscule; nat. size.

,, 3–8. Spicules—

Fig. 3. Promonæne, or plagiomonæne; × 22.
„ 4. Dichotriæne; × 22.
„ 5. Somal anatriæne; × 180.
Fig. 6. Cladal end of radical anatriæne; × 180.
„ 7. Metaster × 360.
„ 8. Plesiaster; × 49.

,, 9. Transverse section through a part of the sponge, showing the ectosome and characters of the choanosome; × 49.

Figs. 10–20. *Thenea delicata*, ... 60

,, 10. Sponge; nat. size.

,, 11, 12. Spicules.

Fig. 11. Radical oxytylote; × 32.
Fig. 12. Tylote end of the preceding; × 180.

,, 13. Median vertical section through the sponge; nat. size.

,, 14–16. Vertical sections taken successively nearer the edge; nat. size.

,, 17. Section through the choanosome, showing the flagellated chambers; × 180.

,, 18. Section through the wall of the cloaca near the margin of the oscule, to indicate the position of the tissue which is shown on a larger scale in the succeeding figure.

,, 19. Section of a part of the wall of the cloaca, containing reserve cells (thesocytes); × 360.

,, 20. Section through two flagellated chambers, one of them in a state of contraction, showing fine filaments proceeding from the choanocytes into the surrounding tissue; × 360.

Figs. 21, 22. *Thenea grayi*, ... 65

,, 21. Vertical median section through the sponge; × 2.

,, 22. Sponge; nat. size.

T.H.Thomas del.

W.J.Sollas dir.

F.Huth, Lith.r Edin.r

Figs 1-9, THENEA WYVILLII. Figs 10-20, THENEA DELICATA. Figs 21 & 22, THENEA GRAYI.

PLATE VII.

PLATE VII.

PAGE

Figs. 1, 2. *Thenea schmidtii*, . . . 67

Figure 1. View of a specimen; nat. size.

„ 2. Section through a part of the choanosome, showing the flagellated chambers and the arrangement of the microscleres; the tangential position of the actines of the calthrops is best seen in the canal in the lower right-hand corner; × 73.

Fig. 3. *Thenea muricata*, ... 95

„ 3. A transverse section through the ectosome and adjacent choanosome, showing the small eurypylous chambers and abundant mesoderm; × 73.

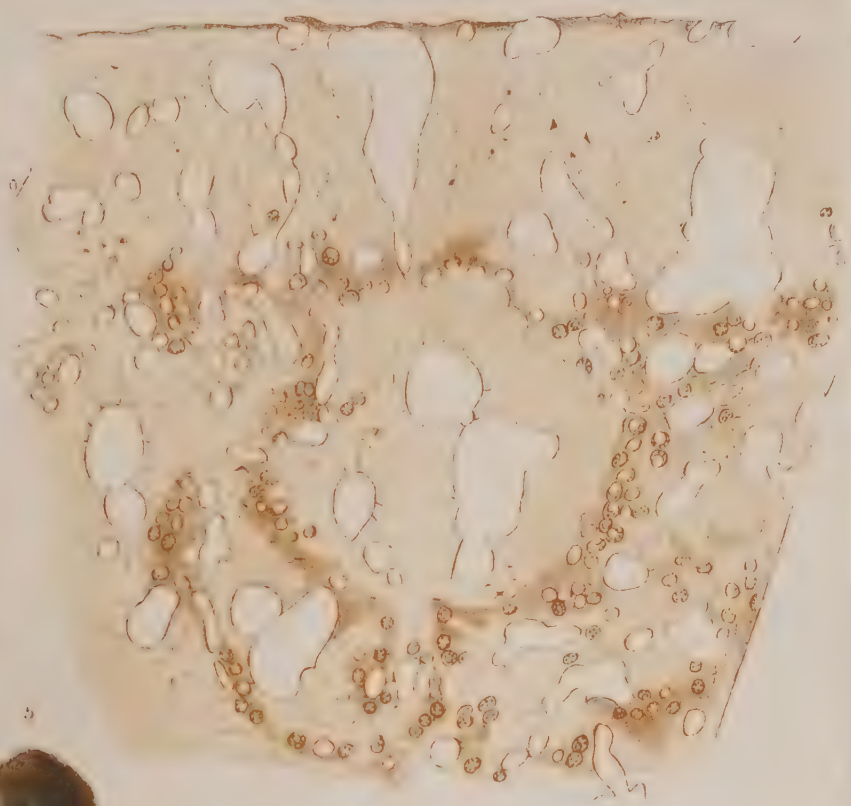
Fig. 4. *Thenea intermedia*, . . . 97

„ 4. A transverse section through the ectosome and adjacent choanosome; × 73.

Fig. 5. *Pilochrota lendenfeldi*, . . . 134

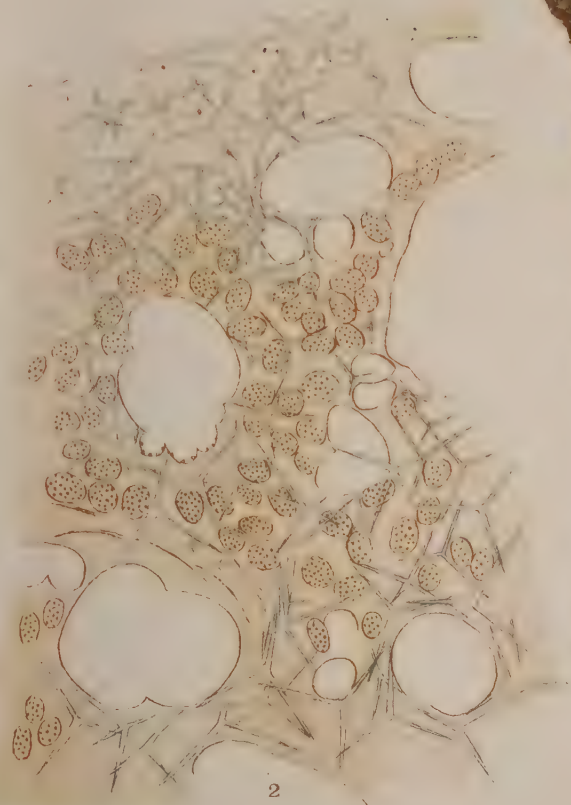
„ 5. View of a specimen; nat. size.

1

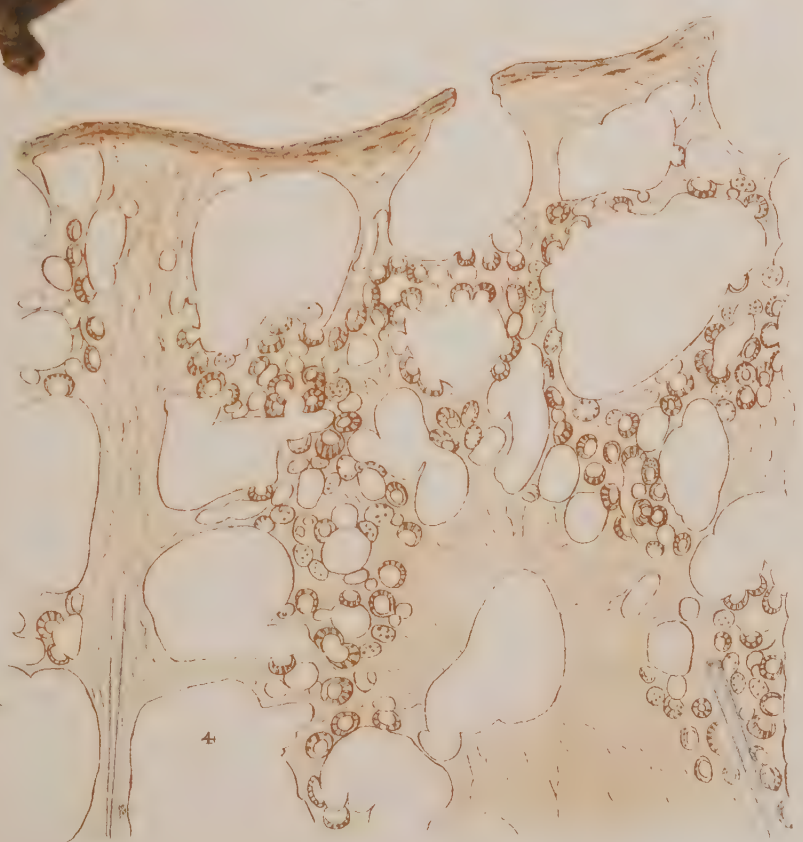


3

5



2



4

T. H. Thomas, del

W. J. Sollas dir.

Geo. West & Sons lith. et imp

1, 2, THENEA SCHMIDTII. 3, THENEA MURICATA.
4, THENEA INTERMEDIA. 5, PILOCHROTA LENDENFELDI.

PLATE VIII.

PLATE VIII.

PAGE

Figs. 1–8. *Thenea fenestrata*, ... 71

Figure 1. Sponge; nat. size.

,, 2–8. Spicules—

Fig. 2. Cladal end of anatriæne, with mesactinal cladome; × 125.
,, 3. Cladal end of anatriæne with terminal cladome; × 180.
Figs. 4–6. Plesiaster, in fig. 6 reduced to a microxea; × 49.
,, 7, 8. Spirasters; × 292.

Figs. 9, 10. *Thenea delicata*, ... 60

,, 9. Transverse section through the sponge, from the exterior a short distance inwards; × 49.

,, 10. Horizontal section through the sponge in the neighbourhood of the cloaca, showing the excurrent canals extending up to the ectosome at *a,a*, though possibly they may have been separated from it in the complete state by the membrane, *b,b*; × 5.

Figs. 11–20. *Thenea wrightii*, ... 63

,, 11. Sponge, seen from above; nat. size.

,, 12. The same, seen from the side; nat. size.

,, 13–19. Spicules—

Fig. 13. Cladal end of anatriæne; × 180.
,, 14–19. The oxyaster and its modifications; fig. 15, a microcalthrops; fig. 16, a microtriod; fig. 19, a microstyle; × 49.

,, 20. Flagellated chambers, showing the fenestrated membrane; × 292.

Figs. 21, 22. *Thenea schmidtii*, ... 69

,, 21. Longitudinal median section of an external bud still attached to the parent; × 49.

,, 22. Longitudinal median section through a young sponge taken from the radical spicules of the adult, on one of which it was seated; × 49.

Fig. 23. *Thenea* sp., ... 77

,, 23. Sponge; nat. size.

Figs. 24–39. *Thrombus challengeri*, ... 275

,, 24. Sponge; nat. size.

,, 25–34. Spicules—

Fig. 25. Plagiotriæne; × 292.
,, 26. The same, seen from above; × 292.
,, 27. Dichotriæne; × 292.
,, 28. The same seen from above; × 292.
,, 29. Plagiodiæne, a reduction of the plagiotriæne; × 292.
,, 30. Trichotriæne; × 292.
Fig. 31. Trichotriæne, with two cladi suppressed; × 292.
,, 32. Young form of plagiotriæne; × 292.
,, 33. Young form of trichotriæne, seen from above; × 292.
,, 34. Young form of dichotriæne; × 292.

,, 35. Section through the ectosome; × 292.

,, 36. Part of a section through the choanosome, showing the diplodal character of the chamber-system; × 292.

,, 37. Section showing a triæne spicule *in situ* with nuclei ranged along its sides; × 292.

,, 38. Similar to the preceding, but with a scleroblast surrounding the spicule about the cladal origin; × 292.

,, 39. Section through the choanosome, showing the general character of the canal-system: the canal with radiating branches is excurrent; × 49.

T.H.Thomas del.

W.J.Sollas dir.

McFarlane & Erskine. Lith.rs Edin.r

Figs 1–8, THENEA FENESTRATA. 9–10, THENEA DELICATA.
11–20, THENEA WRIGHTII. 21–22, THENEA SCHMIDTII.
23, THENEA, sp. 24–39, THROMBUS CHALLENGERI.

PLATE IX.

PLATE IX.

PAGE

Pœcillastra schulzii,[1] 79

Figure 1. Sponge; nat. size.

„ 2–22. Spicules—

Figs. 2, 3. Oxeas; × 40.
„ 4. Orthotriæne; × 51.
„ 5. Calthrops; × 51.
„ 6. Microxea; × 51.
„ 7. Metaster; × 51.
„ 8–13. Metasters; × 360.
„ 14, 15. Spirasters; × 360.
Fig. 16. Modification of the orthotriæne; × 51.
„ 17, 18. Reductions of the calthrops; × 51.
„ 19–21. Microxeas; × 292.
„ 22. Reduced calthrops, approaching an oxea; × 51.

„ 23. Superficial tangential section through the ectosome, showing the irregularly branching subdermal cavities; × 18.

„ 24. Tangential section through the endosome or hypophare; × 18.

„ 25. Part of a section through the choanosome, showing one of the large problematical cells; × 430.

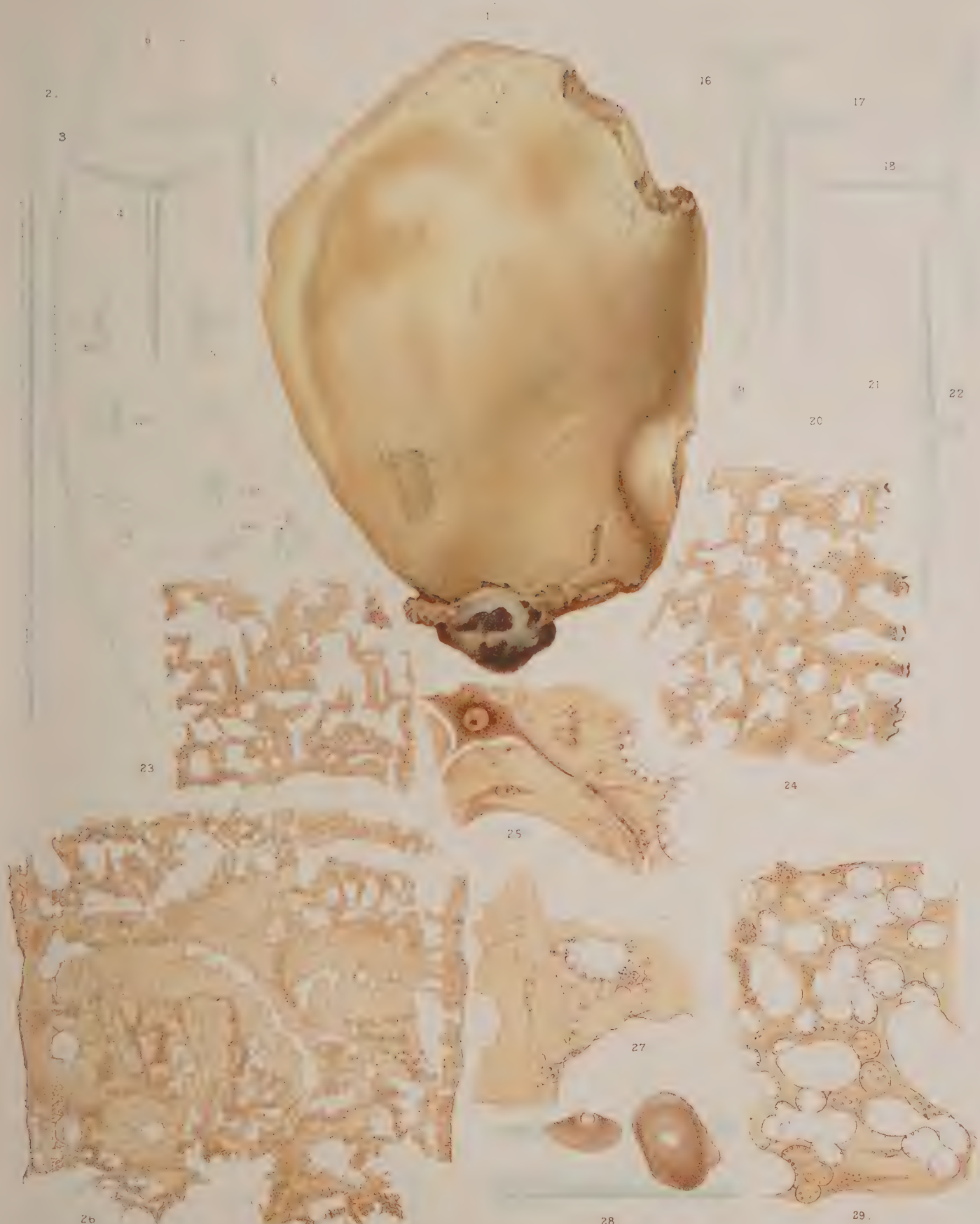
„ 26. Transverse section through the sponge-plate; × 11.

„ 27. Part of a section through the choanosome, showing the continuity of collencytes with choanocytes; × 360.

„ 28. Two spongin bodies seated on a large oxea, one of them surrounding a second smaller oxea; × 292.

„ 29. Part of a section through the choanosome, showing the eurypylous chambers, granule-cells, and a small example of the large problematical cells; × 180.

[1] It has been found necessary to change the generic name since the Plate was printed off.



T. H. Thomas del.

W. J. Sollas dir.

F. Huth, Lith.r Edin.r

NORMANIA SCHULZII.

PLATE X.

PLATE X.

PAGE

Figs. 1–12. *Epallax callocyathus*, ... 423

Figure 1. Sponge; nat. size.

„ 2–9. Spicules—

Fig. 2. Hispidating oxea; × 22.
„ 3. Axial oxea; × 18.
„ 4. Tylostyle, resulting from a reduction of the axial oxea; × 22.
„ 5. Strongyle, similarly produced; × 22.

Fig. 6. Oxyasters; *a*, diactinate (microxea); *b*, microtriod; *c*, tetractinate form; *d*, microcalthrops; × 225.
„ 7. Sphere, also resulting from the reduction of the oxea; × 22.
„ 8. Group of coalesced spheres; × 22.
„ 9. The same; × 125.

„ 10. Vertical longitudinal section through the wall of the sponge; × 9.

„ 11. Part of the choanosome of the preceding, more highly magnified; × 180.

„ 12. The same, still more highly magnified; × 229.

Figs. 13–15. *Sphinctrella cribrifera*, ... 87
Calthropella simplex, ... 107

„ 13. Both sponges; nat. size. *a*, *Sphinctrella cribrifera*; *b*, *Calthropella simplex*.

„ 14. Vertical section through both sponges, and a third sponge—*Astropeplus pulcher*; *a* and *b* as in the preceding figure; *c*. *Astropeplus pulcher*; × 2·5.

„ 15. A vertical section through the outer part of *Pachastrella*[1] *abyssi*, *a*, showing species of *Pœcillastra*,[1] *c*, incrusting the outer surface; × 5.

Figs. 16–20. *Sphinctrella cribrifera*, ... 87

„ 16. The oscule, showing the floor of the cloaca; somewhat magnified, about 4 diameters.

„ 17–20. Spicules—

Fig. 17. Oxea; × 34.
„ 18. Orthotriæne; × 34.
„ 19. An abnormal form of orthotriæne, with an adventitious fourth cladus; × 34.

Fig. 20. Metaster and spiraster; the upper of the two figures is the metaster; × 300.

Figs. 21–29. *Calthropella simplex*, ... 107

„ 21–29. Spicules—

Fig. 21. Calthrops reduced to a diactinate form; × 34.
„ 22. Triod; × 34.
„ 23. Calthrops; × 34.
„ 24. Triod, with the third actine reduced to a spine; × 34.
„ 25. Calthrops reduced to a diactinate form, but with one of the actines traversed by two axial rods, while traces of a fourth are seen at the origin of the axial rods; × 34.

Fig. 26. Calthrops, with several (three) adventitious actines; × 34.
„ 27. Triod with one actine grown out into stunted cladi, and so presenting a resemblance to the epactine of a Lithistid desma; × 34.
„ 28. Spheraster, fully grown; × 225.
„ 29. Young form of spheraster; × 225.

Fig. 30. *Astropeplus pulcher*, ... 422

„ 30. Spicules—

a, Microtriod; *b*, Microcalthrops; *c*, *d*, *e*, Pentactinate forms of aster; *f*, *g*, Smaller asters; × 360.

[1] Both these generic names have been changed since the Plate was printed off.

T.H. Thomas del. W.J. Sollas dir. F. Huth, Lith^y Edin^r

Figs 1-12, EPALLAX CALLOCYATHUS. Figs 13 & 14, SPHINCTRELLA CRIBRIFERA *(a)*. CALTHROPELLA SIMPLEX *(b)*. ASTROPEPLUS PULCHER *(c)*. Figs 15, PICRASTOR ABYSSI *(a)*. NORMANIA INCRUSTANS *(c)*. Figs 16-20, SPHINCTRELLA CRIBRIFERA. Figs 21-29, CALTHROPELLA SIMPLEX. Fig. 30, ASTROPEPLUS PULCHER.

PLATE XI.

PLATE XI.

PAGE

Pachastrella abyssi, ... 104

Figure 1. Sponge; nat. size.

„ 2–23. Spicules—

Fig. 2. Oxea; × 49.
„ 3, 4, 5. Calthrops; × 49.
„ 6. Spiraster; × 49.
„ 7, 8. Metaster; (regarded as a variety of the spiraster); × 540.
„ 9, 10. Spirasters; × 540.
„ 11–13. Microstrongyles; × 540.

Fig. 14. A young form of calthrops; × 540.
„ 15–23. Abnormal forms of calthrops; figs. 15, 19 × 63; figs. 16, 18, 20, 21 × 73; figs. 17, 23, 22 × 95.

„ 24. Part of a section at right angles to the oscular surface, showing an excurrent canal with its oscule; × 4. The circles *a* and *b* indicate the parts chosen for higher magnification in figs. 25 and 26 respectively.

„ 25. Part of the wall of an excurrent canal; × 292.

„ 26. Part of the wall of an excurrent canal more deeply removed from the surface than in the preceding figure; × 292.

„ 27. Granule cells occurring in a collenchymatous matrix; × 576.

„ 28. Section of part of the choanosome, showing the chamber-system; × 225.

„ 29, 30. Parts of a similar section to the preceding, more highly magnified; × 540.

„ 31. A section showing two chambers with a common aphodus; × 360.

T H Thomas del

W. J. Sollas dir.

M^cFarlane & Erskine, Lith^rs Edin^r

PACHASTRELLA ABYSSI.

PLATE XII.

PLATE XII.

PAGE

Figs. 1–28. *Anthastra pulchra*, ... 138

Figure 1. Sponge; nat. size.

„ 2–22. Spicules—

Fig. 2. Oxea; × 49.
„ 3. Orthotriæne; × 49.
„ 4. Anatriæne; × 49.
„ 5. Asters; × 49.
„ 6. Chiaster; × 292.
„ 7–13. Various forms of anthaster; × 292.
„ 14, 15. Chiasters; × 292.
„ 16. Young form of anatriæne; × 292.
„ 17. The same, more advanced; × 292.
Fig. 18. The same, still more advanced; × 292.
„ 19. Young form of orthotriæne (the actines are more porrectate than in the adult); × 292.
„ 20, 21. Young forms of anthaster; × 292.
„ 22. Young form of orthotriæne, the cladome seen from above, showing the remains of the tylus.

„ 23. Vertical median section through the sponge; × 4.

„ 24. Section through a part of the ectosome, showing a pore communicating with a subdermal cavity; × 73.

„ 25. Section through the outer part of the ectosome; × 292.

„ 26. Section through the ectosome and part of the choanosome to show the subdermal cavities; × 15.

„ 27. Tangential section through the ectosome, showing lateral extension of the subdermal cavities; × 15.

„ 28. Section showing flagellated chambers; × 576.

Figs. 29–33. *Myriastra simplicifurca*, ... 114

„ 29. Sponge; nat. size.

„ 30–33. Spicules—

Fig. 30. Oxea; × 32.
„ 31. Orthotriæne; × 32.
Fig. 32. Anatriæne; × 32.
„ 33. Chiasters; × 292.

Figs. 34–43. *Myriastra clavosa*, ... 116

„ 34. Sponge; nat. size.

„ 35–38. Spicules—

Fig. 35. Oxea; × 32.
„ 36. Dichotriæne; × 32.
Fig. 37. Anatriæne; × 32.
„ 38. Chiasters; × 292.

„ 39. Vertical median section through the sponge; × 11.

„ 40. Vertical section passing tangentially through the walls of the cloaca; × 11.

„ 41. Section through a part of the ectosome; × 292.

„ 42. Section showing the sarcencytes of the sarcenchyma; × 292.

„ 43. Cladome of an anatriæne, showing the extension over it of the scleroblast; × 292.

T. H. Thomas del. W. J. Sollas dir. F. Huth, Lith.r Edn.r

Figs 1-28, ANTHASTRA PULCHRA. Figs 29-33, MYRIASTRA SIMPLICIFURCA.
Figs 34-43, MYRIASTRA CLAVOSA.

PLATE XIII.

PLATE XIII.

PAGE

Figs. 1–29. *Anthastra communis*, ... 140

Figure 1. Sponge; nat. size.

„ 2–6. Spicules—

Fig. 2. Oxea; × 32.
„ 3. Dichotriæne; × 32.
„ 4. Anatriæne; × 32.
Fig. 5. Anthaster; × 430.
„ 6. Chiaster; × 430.

„ 7. Section through the outer part of the ectosome; × 200.

„ 8. Radial section through a part of the choanosome, showing the relations of the excurrent and incurrent canals; × 70.

„ 9. Section through a part of the choanosome, showing flagellated chambers, with their aphodi; × 360.

„ 10. Cavity in the choanosome, left by the tearing away of a megasclere, showing the remains of the scleroblast; × 292.

„ 11. Section through a part of the choanosome, showing anastomosing aphodi.

„ 12. Another sponge of the same species, originally regarded as distinct; nat. size.

„ 13. Two sponges of the same species united in growth; nat. size.

„ 14–28. Spicules—

Fig. 14. Oxea; × 32.
„ 15. Dichotriæne; × 32.
„ 16. Early stage in the growth of the dichotriæne; × 180.
„ 17. A stage somewhat later; × 49.
„ 18. A stage later still; × 49.
Fig. 19. Cladal end of adult dichotriæne, with a cyathiform cladome; × 32.
„ 20. Cladal end of a young form of anatriæne; × 180.
„ 21. Cladal end of adult anatriæne; × 32.
„ 22–24. Anthasters; × 292.
„ 25–28. Chiasters; × 430.

„ 29. Part of the rhabdome of a young anatriæne, showing the nuclear portion of the scleroblast; × 292.

Figs. 30–40. *Anthastra parvispicula*, ... 145

„ 30. Sponge; nat. size.

„ 31–38. Spicules—

Fig. 31. Oxea; × 49.
„ 32. Orthotriæne; × 49.
„ 33. Anatriæne; × 49.
Fig. 34. Cladal end of anatriæne, more highly magnified; × 180.
„ 35–37. Anthasters; × 430.
„ 38. Chiaster; × 430.

„ 39. Section through ectosome and adjacent choanosome to show the passage of the subdermal cavities into the incurrent canals; × 15.

„ 40. Section through the ectosome; × 49.

T H Thomas del. W. J. Sollas dir. F Huth, Lith^r Edin^r

Figs 1-29, ANTHASTRA COMMUNIS. Figs 30-40, ANTHASTRA PARVISPICULA.

PLATE XIV.

PLATE XIV.

PAGE

Figs. 1–8. *Pilochrota haeckeli*, ... 120

Figure 1. Sponge; nat. size.

„ 2–6. Spicules—

Fig. 2. Oxea; × 34.
„ 3. Orthotriæne; × 34.
„ 4. Anatriæne; × 34.
Fig. 5. Anthaster; × 430.
„ 6. Chiaster; × 430.

„ 7. Section through the outer part of the cortex in the neighbourhood of a chone; × 180.

„ 8. One of a cluster of cells; × 430.

Figs. 9–15. *Pilochrota crassispicula*, ... 128

„ 9. Sponge; nat. size.

„ 10–13. Spicules—

Fig. 10. Oxea; × 34.
„ 11. Orthotriæne; × 34.
Fig. 12. Anthaster; × 430.
„ 13. Chiaster; × 430.

„ 14. Section through part of the cortex and choanosome of the sponge, including the margin of the oscule; × 15.

„ 15. A part of the tissue forming the membranous margin of the oscule, more highly magnified; × 180.

Figs. 16–22. *Pilochrota anancora*, ... 132

„ 16. Sponge; nat. size.

„ 17–20. Spicules—

Fig. 17. Oxea; × 49.
„ 18. Plagiotriæne; × 49.
Figs. 19, 20. Chiasters; × 430.

„ 21. Section of the exterior of the sponge, showing cortex and choanosome; × 15.

„ 22. One of the clusters of cells shown in the preceding figure as dark spots in the cortex; × 430.

Figs. 23–28. *Myriastra subtilis*, ... 113

„ 23. Sponge; nat. size.

„ 24–28. Spicules—

Fig. 24. Oxea; × 32.
„ 25. Dichotriæne; × 32.
Fig. 26. Anatriæne; × 32.
„ 27, 28. Chiasters; × 430.

Figs. 29–36. *Myriastra toxodonta*, ... 119

„ 29. Sponge; nat. size.

„ 30–35. Spicules—

Fig. 30. Oxea; × 32.
„ 31. Dichotriæne; × 32.
Fig. 32. Anatriæne; × 32.
„ 33–35. Chiaster; × 430.

„ 36. Radial section, showing the general character of the canal-system; × 15.

Fig. 37. *Pilochrota purpurea*, var. *longancora*, ... 131

„ 37. Transverse section through a part of the cortex, showing the structure of one of the gland-like cell clusters; × 292.

T.H.Thomas del

W.J.Sollas dir

M.cFarlane & Erskine Lith.rs Edin.r

Figs. 1–8, PILOCHROTA HAECKELI.
9–15, P. CRASSISPICULA.
16–22, P. ANANCORA.

Figs. 23–28, MYRIASTRA SUBTILIS.
29–36, M. TOXODONTA.
37, PILOCHROTA LONGANCORA.

PLATE XV.

PLATE XV.

PAGE

Figs. 1–19. *Anthastra pyriformis*, ... 146

Figure 1. Sponge ; nat. size.

„ 2. Sponge, cut through vertically ; nat. size.

„ 3–11. Spicules—

Fig. 3. Oxea; × 39.
„ 4, 5. Dichotriænes; × 39.
„ 6. Protriæne or plagiotriæne; × 39.
„ 7. Anatriæne; × 39.
„ 8. Cladome of an anatriæne; × 180.
Fig. 9. Cladome of an abnormal triæne, with four cladi; × 180.
„ 10. Anthaster; × 430.
„ 11. Chiaster; × 430.

„ 12. Part of a vertical median section, showing the ectosome and the character of the chones ; × 15.

„ 13. Transverse section through the wall of a canal, showing the epithelial cells raised into projections by the actines of the asters, which are not seen, owing to the preparation being mounted in glycerine ; beneath the epithelium granule cells are shown ; × 400.

„ 14, 15. Transverse sections through the ectosome, showing a plexus of collencytes, some of which are directed towards the epithelium, like palpocils ; × 292.

„ 16. Fusiform cells, which sometimes occur wrapping round the megascleres ; × 292.

„ 17. Diagram of a velum, showing collencytes radiating from the wall of the canal in which it occurs.

„ 18. Transverse section of the symbiotic Diatom—*Amphora archeri ;* × 300.

„ 19. Longitudinal section of the preceding; × 300.

Figs. 20–27. *Anthastra communis*, ... 140

„ 20. Cribriporal roof of a subdermal cavity, lower surface seen *en face ;* × 180.

„ 21. Transverse section through the wall of a canal, showing the epithelium raised into projections by the actines of the chiasters ; × 360.

„ 22. Two epithelial cells seen *en face*, one with a contained chiaster ; × 360.

„ 23–27. Spicules—

Fig. 23. Oxea; × 49.
„ 24. Dichotriæne; × 49.
„ 25. Anatriæne; × 49.
Fig. 26. Anthaster; × 360.
„ 27. Chiaster; × 360.

Figs. 28–32. *Pilochrota tenuispicula*, ... 127

„ 28. Sponge ; nat. size.

„ 29–31. Spicules—

Fig. 29. Oxea; × 32.
„ 30. Orthotriæne; × 32.
Fig. 31. Chiaster; × 430.

„ 32. Transverse section through the cortex, in the region of a chone ; × 7.

Figs. 33–39. *Stryphnus unguiculus*, ... 195

„ 33–39. Spicules—

Fig. 33. Somal oxea; × 32.
„ 34. Dichotriæne; × 32.
„ 35. Cladal end of dichotriæne; × 180.
Fig. 36. Cladome of dichotriæne, seen *en face ;* × 180.
„ 37. Choanosomal oxyaster; × 292.
„ 38, 39. Somal amphiasters ; × 292.

Figs. 40–46. *Corallistes thomasi*, ... 307

„ 40–46. Spicules—

Fig. 40. Dichotriæne ; × 180.
„ 41. Cladome of dichotriæne seen from below ; × 180.
Fig. 42. Young form of dichotriæne ; × 180.
„ 43. Strongylospires ; × 430.
„ 44–46. Spirasters ; × 292.

T.H. Thomas del. W.J. Sollas dir. F. Huth, Lith.r Edin.r

Figs 1-19, ANTHASTRA PYRIFORMIS. Figs 20-27, ANTHASTRA COMMUNIS. Figs 28-32, PILOCHROTA TENUISPICULA.
Figs 33-39, STRYPHNUS UNGUICULUS. Figs 40-46, CORALLISTES THOMASI.

PLATE XVI.

PLATE XVI.

PAGE

Figs. 1–5. *Astrella vosmaeri*, ... 136

Figure 1. Sponge, seated on a specimen of *Stelletta phrissens*; nat. size.

„ 2–5. Spicules—

Fig. 2. Dichotriæne; × 32.
„ 3. Cladal end of anatriæne; × 95.
„ 4. Pycnaster; × 540.
Fig. 5. Abnormal termination of an oxea, resembling an anamonæne; × 32.

Figs. 6–20. *Stelletta phrissens*, ... 150

„ 6, 7. Two examples of the sponge; nat. size.

„ 8–11. Spicules—

Fig. 8. Dichotriæne; × 32.
„ 9. Cladal end of anatriæne; × 292.
Fig. 10. Oxyaster; × 540.
„ 11. Spheraster; × 540.

„ 12. Radial section through the cortex; × 49.

„ 13. Transverse section through the inner fibrous layer of the cortex; × 292.

„ 14. Transverse section through an excurrent canal and adjacent sarcenchyma; × 180.

„ 15. Transverse section through the ectosome and adjacent choanosome of the very young sponge; × 360.

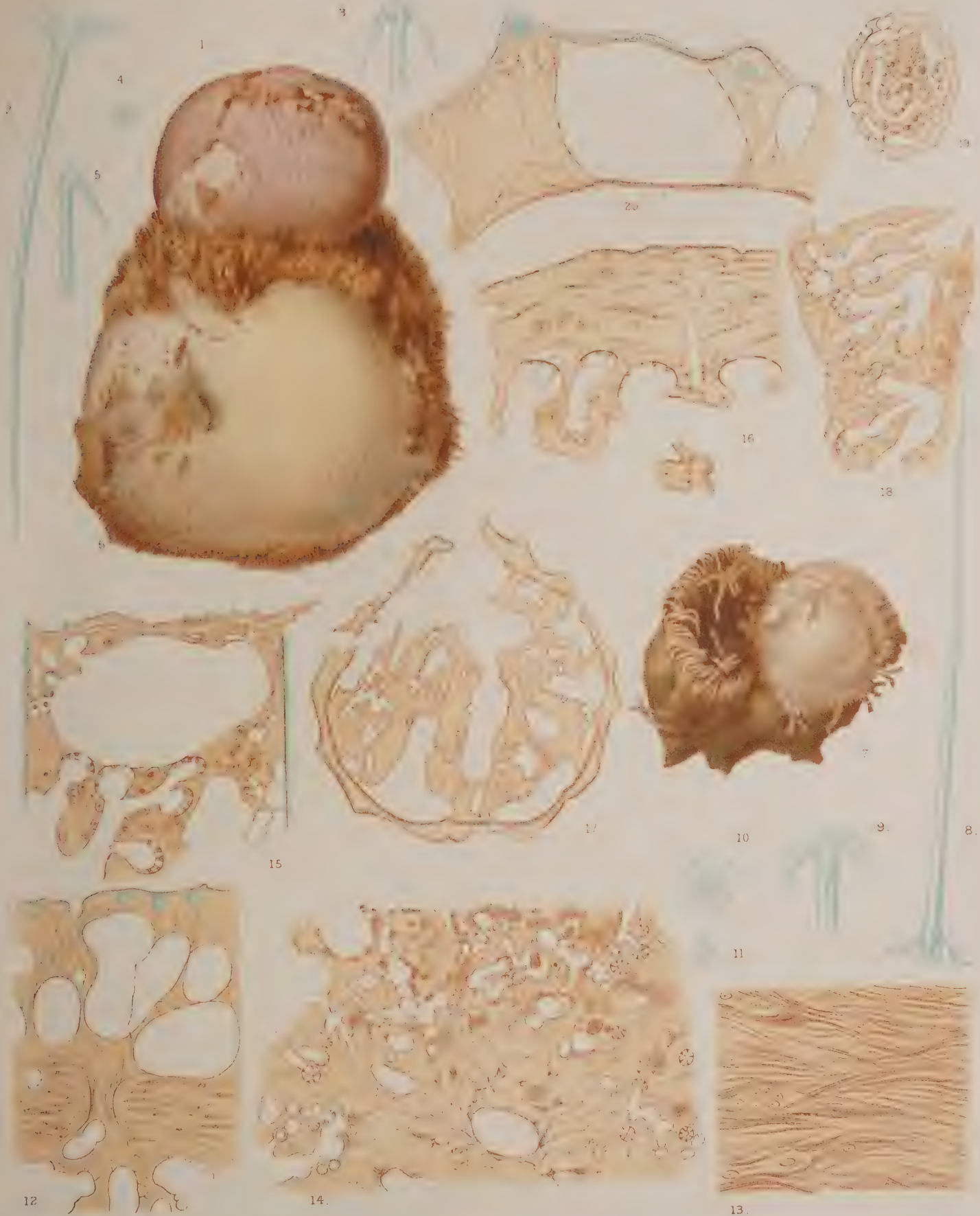
„ 16. A similar section taken from a still younger sponge than the preceding; × 360.

„ 17. Vertical median section through a young sponge, more advanced than the preceding; × 49. (This is worked out in greater detail in the woodcut on page xxiii.)

„ 18. Section through the choanosome of the youngest example met with, showing that the aphodal character of the chamber system is established at a very early stage; × 292.

„ 19. Transverse section through the sponge at a later stage than that of fig. 17; × 10.

„ 20. Transverse section through the cortex of fig. 19; × 125.



"H. Thomas del.

W. J. Sollas dir.

F. Huth. Lith.r Edin.r

Figs. 1-5, ASTRELLA VOSMAERI. Figs. 6-20, STELLETTA PHRISSENS.

PLATE XVII.

PLATE XVII.

PAGE

Tribrachium schmidtii, ... 154

Figure 1. Several examples of the sponge; nat. size.

„ 2–8. Spicules—

Fig. 2. Oxea; × 32.
„ 3. Somal orthotriæne; × 32.
„ 4. Anatriæne; × 32.
„ 5. Cladal end of an anatriæne; × 292.
Fig. 6. Cladal end of an anatriæne, reduced to an anamonæne; × 292.
„ 7. Cloacal orthodiæne; × 32.
„ 8. *a–d*, various forms of sanidaster; *c*, closely approaches a chiaster; × 576.

„ 9. Vertical median section through the body of the sponge, including the basal portion of the cloacal tube; × 7.

„ 10. A part of the preceding, more highly magnified to show the passage of the cloacal tube into the body; × 15.

„ 11. The skeleton of the basal part of the cloacal tube seen *en face*; × 49.

„ 12. Longitudinal transverse section through the base of the cloacal tube, showing the development of the orthodiænes; × 300.

„ 13. Part of a transverse section through the base of the cloacal tube and surrounding choanosome of the sponge body. The part of the figure below "13" represents the tissue of the cloacal tube; × 15.

„ 14. Part of the preceding, showing the arrangement of the spicules of the cloacal tube in radial series, the youngest spicules being situated nearest the exterior (lower part of the figure); × 180.

„ 15. Longitudinal section through the cloacal tube, showing the general disposition of the soft parts; × 15.

„ 16. Longitudinal but not median section through the cloacal tube, cutting the inner wall tangentially; × 15.

„ 17. Transverse section through the base of the cloacal tube and surrounding sponge; dichotriænes occur in this region, but nowhere else; × 15.

„ 18. Transverse section through the cloacal tube; × 15.

„ 19. A single example of an oxyaster observed within its scleroblast; × 430.

„ 20. The youngest example of orthodiæne observed, seen within its scleroblast; × 300.

„ 21. One of the granule cells which occur somewhat abundantly scattered through the choanosome; × 292.

T. H. Thomas, del W. J. Sollas dir. Geo. West & Sons lith. et imp

TRIBRACHIUM SCHMIDTII (Weltner).

PLATE XVIII.

PLATE XVIII.

PAGE

Disyringa dissimilis, ... 161

Figure 1. The cloacal tube of which fig. 18 is a transverse section; nat. size.

„ 2. The cloacal tube of another specimen, showing the expanded hispidated termination; nat. size. The position of this is inverted if the sponge be placed in the position of fig. 3.

„ 3. Cloacal tube continuous with one-half of the sponge body; nat. size.

„ 4–13. Spicules—

Fig. 4. Orthoenomene; × 32.
„ 5. Orthotriæne, with cladus much over developed; × 32.
„ 6. Dichomonæne; × 32.
„ 7. Cladome of a triæne seen *en face*; one cladus is simple and well developed, one reduced to a tubercle, and the third is a Cladocladus with the deuterocladi reduced to tubercles; × 32.
Fig. 8. Sexual orthodiæne; × 32.
„ 9. Sexual orthomonæne; × 32.
„ 10. Sexual oxea; × 32.
„ 11. Sanidaster; × 540.
„ 12. Oxyaster; × 540.
„ 13. Orthotriæna, with its scleroblast; × 54[illegible].

„ 14. Transverse section through a part of the sponge, showing the cortex and a part of the choanosome; × 22.

„ 15. Transverse section through a cloacal tube with four canals; × 10.

„ 16. 16*a*. Sections through part of the choanosome, showing the flagellated chambers; × 225.

„ 17. Part of a longitudinal section through the cloacal tube of which fig. 15 is a transverse section; × 11.

„ 18. Transverse section through a cloacal tube, with 16 – 1 canals; × 5·5. I. primary canals; II. secondary; and III. tertiary canals.

„ 19. A part of the preceding section, more highly magnified; × 16.

„ 20. Section through the outer wall of the cloacal tube, with some of the adjacent strands of collenchyma, containing large pale vesicular cells; × 225.

„ 21. One of the vesicular cells of fig. 20; × 36

„ 22. A flagellated chamber, showing the fenestrated membrane; × 540.

„ 23. Part of the outer wall of the cloacal tube from the outside, showing the longitudinal and transverse strands of fusiform cells which divide it into pore areas; × 360.

„ 24. Tissue adjacent to one of the spicules of the cloacal tube, showing fibrillated fusiform cells extending over the spicule, and between them deeply coloured granular collencytes; × 200.

„ 25. A fusiform cell from a spicule tract; × 360.

„ 26. The fusiform middle part of a myocyte; × 360.

DISYRINGA DISSIMILLIS.

PLATE XIX.

PLATE XIX.

PAGE

Stryphnus niger, ... 171

Figure 1. Sponge, growing on *Gelliodes poculum*, Ridley and Dendy; nat. size.

„ 2–9. Spicules—

Fig. 2. Oxea; × 32.
„ 3. Dichotriæne; × 32.
„ 4. An oxea not proper to the sponge, derived from without; × 73.
„ 5. Oxyaster; × 73.
Fig. 6. Dichotriæne; × 73.
„ 7. The oxea of fig. 4 more highly magnified; × 360.
„ 8. Oxyaster; × 360.
„ 9. Amphiaster; × 430.

„ 10. Transverse section through the outer part of the sponge, showing the absence of chones in the cortex; × 15.

„ 11. Section showing the histology of the cortex; × 292.

„ 12. Part of a section through the choanosome; × 292.

„ 13. Similar to the preceding, but showing one of the darkly stained cells of the choanosome; × 292.

„ 14, 15. Problematical elements from the cortex; × 430.

„ 16–21. Pigment cells in various stages of development; × 430.

T. H. Thomas, del

W. J. Sollas dir

Geo. West & Sons lith. et imp.

STRYPHNUS NIGER.

PLATE XX.

PLATE XX.

PAGE

Figs. 1–13. *Pilochrota gigas*, ... 124

Figure 1. Sponge; nat. size.

„ 2–6. Spicules—

Fig. 2. Isoactinate oxea; × 39.
„ 3. Anisoactinate oxea; × 39.
Fig. 4. Orthotriæne; × 39.
„ 5, 6. Chiast^{e}r; × 360.

„ 7. Part of a transverse section through the sponge; × 16.

„ 8. Section through part of the choanosome, showing the pale granular cells; × 360.

„ 9. Part of section through one of the fibrous bands of attachment; × 292.

„ 10. Median longitudinal section through one of the fibrous bands of attachment, the upper end of the figure includes a part of the body of the sponge; × 16.

„ 11. A part of the foregoing section, more highly magnified, the contorted lines indicate wrinkled fusiform cells; × 540.

„ 12. A part of section shown in fig. 10, including the surface of attachment; × 292.

„ 13. Another portion of the same section, to show more darkly stained protoplasmic cells in association with the pale granular cells; × 292.

Figs. 14–21. *Cydonium glariosus*, ... 223

„ 14. Sponge; nat. size.

„ 15–21. Spicules—

Fig. 15. Orthotriæne; × 28.
„ 16. Protriæne; × 28.
„ 17. Anatriæne; × 28.
„ 18. Sterraster; × 225.
Fig. 19. Choanosomal oxyaster; × 540.
„ 20. Subcortical spheraster; × 540.
„ 21. Cladal end of anatriæne; × 180.

Fig. 22. *Cydonium cosaster*, ... 225

„ 22. Transverse section through an excurrent canal and surrounding choanosome; × 125.

T. H. Thomas, del W. J. Sollas dir. Geo. West & Sons lith. et imp

1—13 PILOCHROTA GIGAS.
14—21 CYDONIUM GLARIOSUS.
22 CYDONIUM EOSASTER.

PLATE XXI.

PLATE XXI.

PAGE

Figs. 1–14. *Cydonium magellani*, ... 223

Figure 1. Sponge, attached to a small example of *Astrella vosmaeri*; nat. size.

„ 2–8. Spicules—

Fig. 2. Oxea; × 29.
„ 3. Dichotriæne; × 29.
„ 4. Cladal end of a dichotriæne with a more cyathiform cladome; × 32.
Fig. 5. Anatriæne; × 29.
„ 6. Sterraster; × 75.
„ 7. Somal strongylate spheraster; × 430.
„ 8. Choanosomal oxyaster; × 430.

„ 9. Median longitudinal section through a chone; × 35.

„ 10. Tangential section through a part of the ectochrote; × 292.

„ 11. Oblique tangential section, passing through the inner face of the cortex and the adjacent choanosome; the sphincters of two chones are seen as darkly stained rings; × 22.

„ 12. Section through part of the choanosome, showing a flagellated chamber and surrounding sarcencytes; × 292.

„ 13. Transverse section across the myocytes of a chonal sphincter; × 540.

„ 14. Transverse section through the cortex, showing the hispidation produced by the oxeas and triænes; × 11.

Figs. 15–29. *Cydonium vosaster*, ... 225

„ 15. Sponge; nat. size.

„ 16–26. Spicules—

Fig. 16. Oxea; × 32.
„ 17. Cladal end of dichotriæne; × 32.
„ 18. Cladal end of anatriæne; × 73.
„ 19. Cladal end of anatriæne; × 32. Drawn to same scale as fig. 17 for comparison.
„ 20. Cladal end of protriæne; × 32.
„ 21. Sterraster; × 73.
Fig. 22. Spheraster; × 73.
„ 23. Spheraster; × 292.
„ 24. Somal spheraster; × 360.
„ 25. Choanosomal oxyaster; × 360.
„ 26. Choanosomal oxyaster, another example; × 360.

„ 27. Transverse section through the sponge, showing the continuation of the chonal canals inwards, till they communicate with a deep lying concentric canal; × 11.

„ 28. Section through the sponge, taken on one side of the medial plane; × 11.

„ 29. Section taken longitudinally through the middle of a chone; × 73.

Figs. 30–42. *Cydonium hirsutus*, ... 218

„ 30. Part of the sponge; nat. size.

„ 31. Transverse section, showing the unusually thick cortex and cavernous choanosome; nat. size.

„ 32–42. Spicules—

Fig. 32. Oxea; × 28.
„ 33. An oxea, not proper to the sponge; × 73.
„ 34. Cladal end of dichotriæne; × 28.
„ 35. Sterraster, presenting the face bearing the hilum; × 28.
„ 36. The same, seen from the side at right angles to that bearing the hilum; × 28.
„ 37. Surface of the sterraster; × 540.
„ 38. Part of a transverse section, showing the two actines of the sterraster with intervening spicular substance, the axial rods of the actines are also shown; × 430.
Fig. 39. Tangential section of the sterraster, taken through the actines at a level exterior to that at which they become soldered together; × 540.
„ 40. Section transverse to the actines, taken deeper in; × 430.
„ 41. Cortical spheraster; × 312.
„ 42. Somal spheraster; × 430.

T. H. Thomas, del. W. J. Solles dir. Geo. West & Sons lith. et imp.

1—14 CYDONIUM MAGELLANI.
15—29 CYDONIUM EOSASTER.
30—42 CYDONIUM HIRSUTUS.

PLATE XXII.

PLATE XXII.

PAGE

Synops nitida, ... 231

Figure 1. Part of the sponge, showing the upper (or ocular) surface, and median plane of fracture; nat. size.

„ 2. Sponge, seen from below; nat. size.

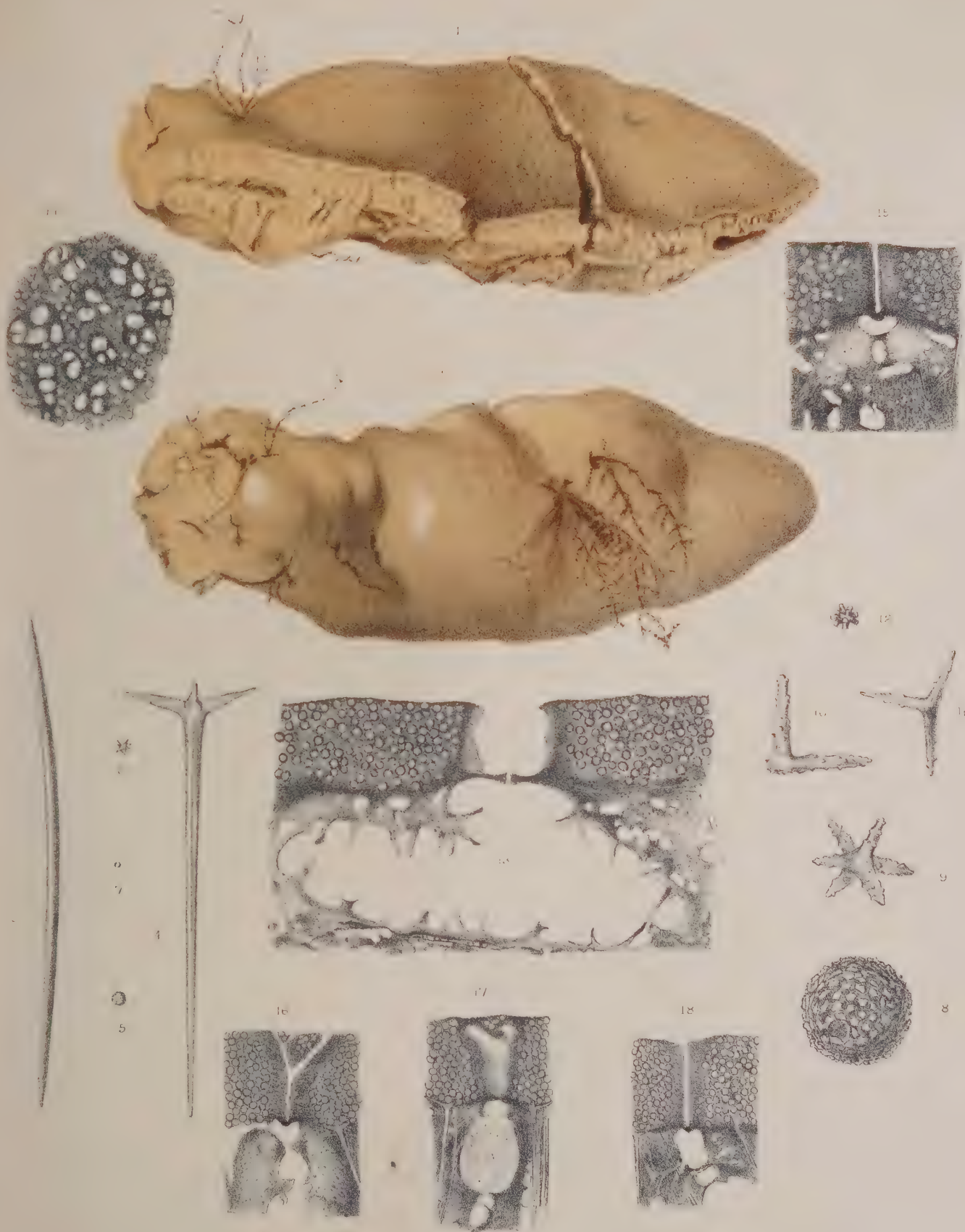
„ 3–12. Spicules—

Fig. 3. Oxea; × 73.
„ 4. Orthotriæne; × 73.
„ 5. Sterraster; × 73.
„ 6. Choanosomal oxyaster; × 73.
„ 7. Somal spheraster; × 73.
Fig. 8. Sterraster; × 430.
„ 9–11. Choanosomal oxyaster and its modifications; × 430.
„ 12. Somal spheraster; × 430.

„ 13. Section passing through the middle of an oscule longitudinally; × 32.

„ 14. Tangential slice, showing the pore-sieves; × 32.

„ 15–18. Longitudinal median sections through chones; × 32.



T. H. Thomas, del W. J. Sollas dir Geo. West & Sons, lith. et imp

SYNOPS NITIDA.

PLATE XXIII.

PLATE XXIII.

PAGE

Synops rosmaeri 234

Figure 1. Sponge; nat. size.

„ 2. Vertical median section through the sponge; nat. size.

„ 3–13. Spicules—

Figs. 3, 4. Somal oxeas; × 73.
„ 5. Orthotriæne; × 73.
„ 6. Cortical oxea; × 73.
„ 7. Sterraster; × 73.
„ 8. Choanosomal oxyaster; × 73.
„ 9. Sterraster; × 225.
Fig. 10. Choanosomal oxyaster; × 292.
„ 11. Somal spheraster; × 700.
„ 12. Termination of somal oxea; × 292.
„ 13. Abnormal form of oxea or plagiomonæne; × 73.

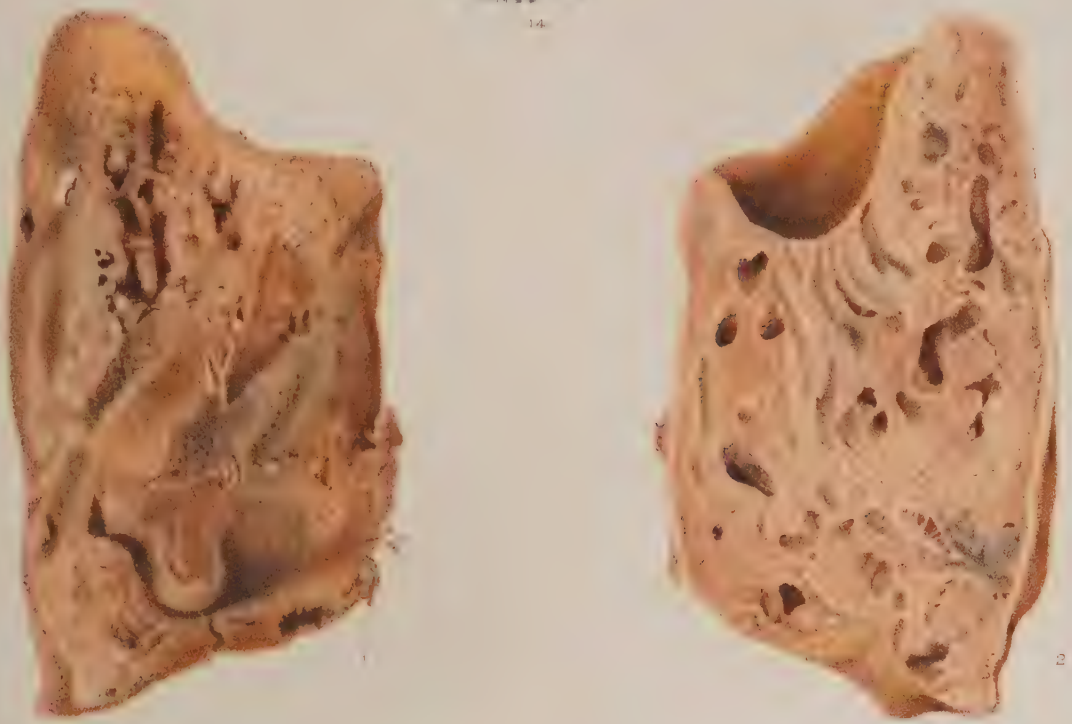
„ 14. Section passing medially and longitudinally through an oscule; × 2.

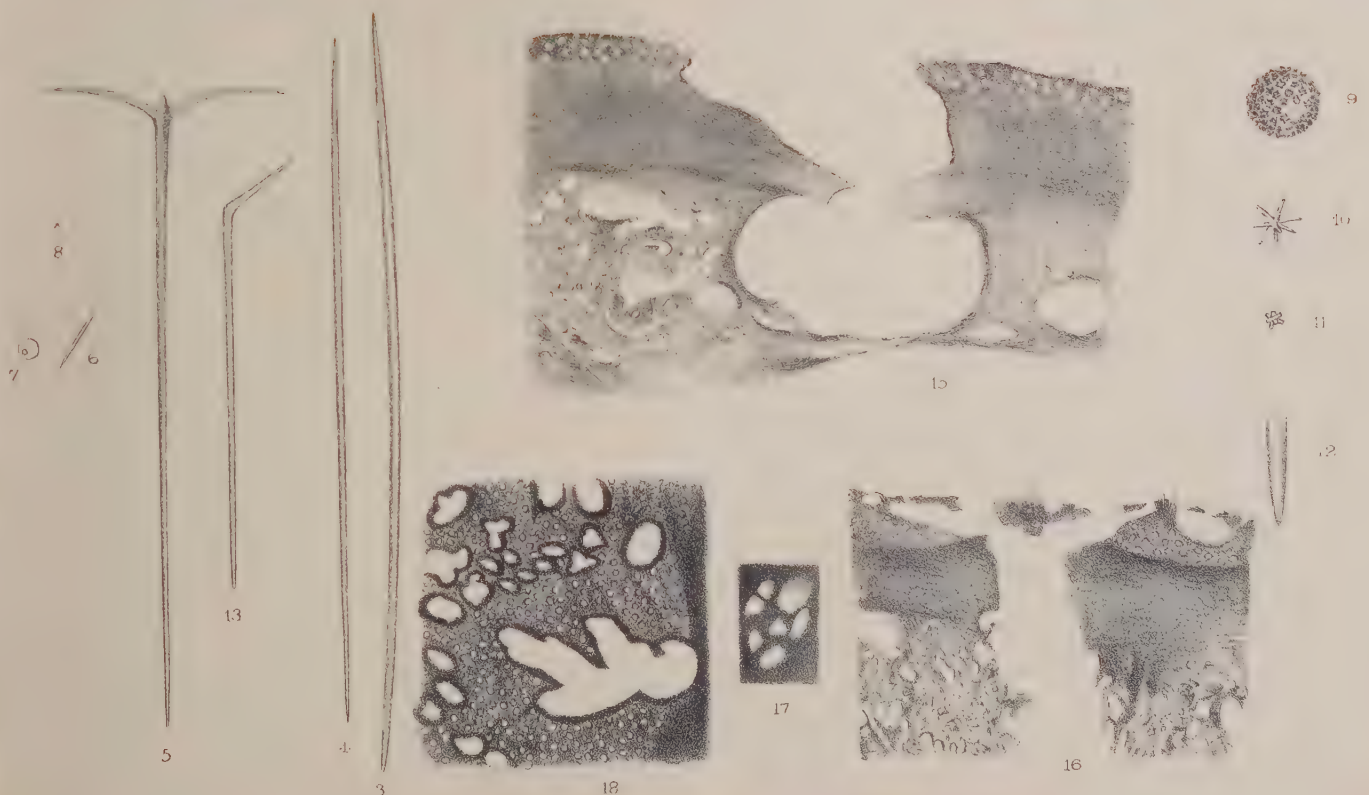
„ 15. Median longitudinal section through an oscular chone, showing the general characters of the cortex and choanosome; × 32.

„ 16. Median longitudinal section through an incurrent chone; × 32.

„ 17. A sieve-pore seen *en face*.

„ 18. Oblique, nearly tangential section through the outer part of the cortex, showing the lateral extension of the canals which extend from the pores to the chones.





T. H. Thomas, del W. J. Sollas dir. Geo West & Sons lith. et imp

SYNOPS VOSMAERI.

PLATE XXIV.

PLATE XXIV.

PAGE

Synops neptuni, ... 227

Figure 1. Sponge ; one-half the natural size.

T. H. Thomas, del W. J. Sollas dir. Geo. West & Sons, lith. et imp.

SYNOPS NEPTUNI.

PLATE XXV.

PLATE XXV.

PAGE

Synops neptuni, ... 227

Figure 1. Vertical median section through the sponge; one-half the natural size.

T. H. Thomas, del. W. J. Sollas dir. Geo. West & Sons, lith et imp.

SYNOPS NEPTUNI.

PLATE XXVI.

PLATE XXVI.

PAGE

Synops neptuni, ... 227

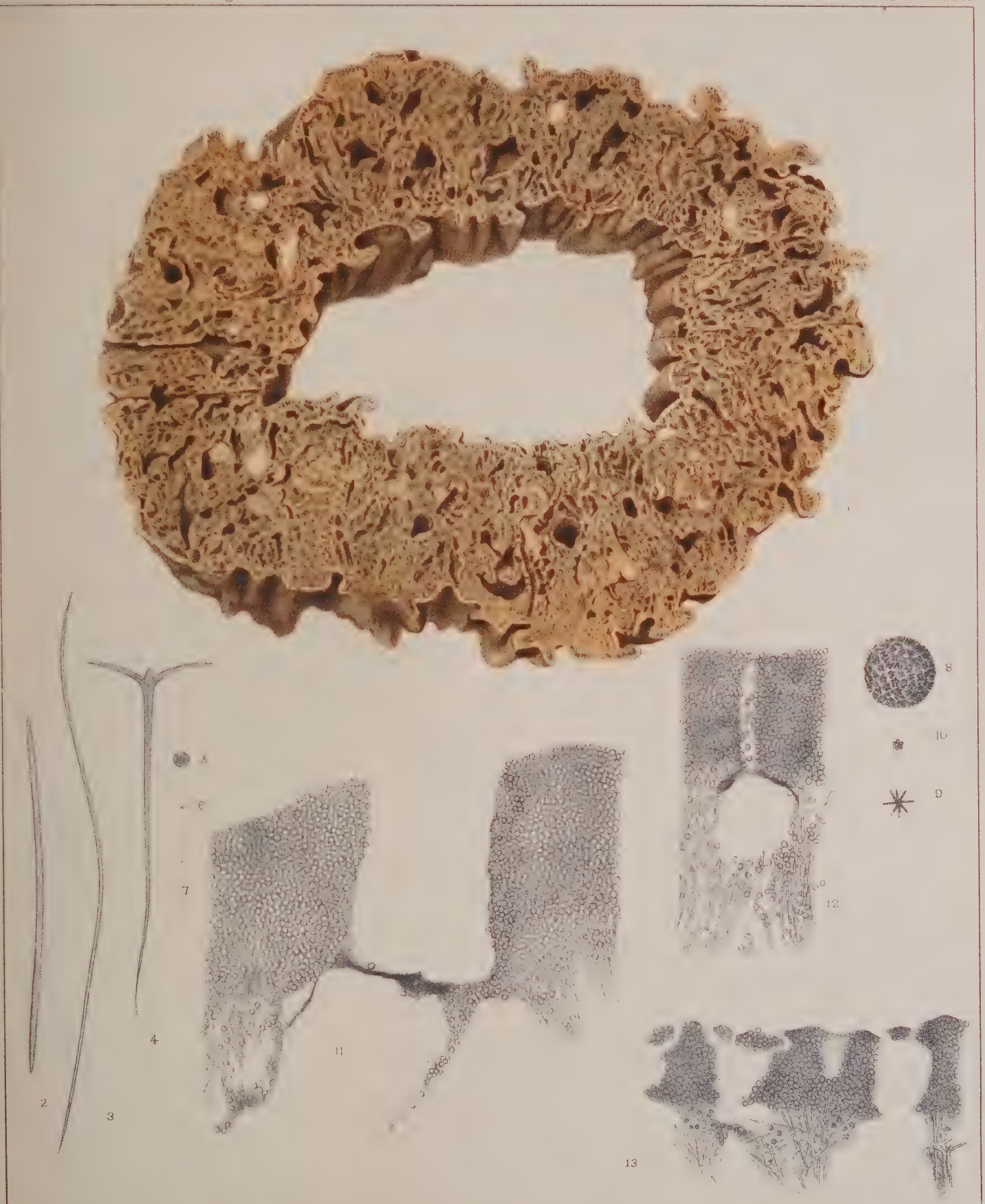
Figure 1. Transverse section through the sponge; one-half the natural size.

„ 2–10. Spicules—

Figs. 2, 3. Oxeas; × 73.
„ 4. Orthotriæne; × 73.
„ 5. Spheraster; × 73.
„ 6. Choanosomal chiaster; × 73.
Fig. 7. Somal chiaster; × 73.
„ 8. Sterraster; × 292.
„ 9. Choanosomal chiaster; × 360.
„ 10. Somal chiaster; × 292.

„ 11, 12. Transverse sections through the cortex, passing longitudinally through the middle of excurrent chones; × 32.

„ 13. Transverse section through the cortex passing through two incurrent chones; × 32.



T. H. Thomas, del W. J. Sollas dir. Geo. West & Sons, lith et imp

SYNOPS NEPTUNI.

PLATE XXVII.

PLATE XXVII.

PAGE

Caminus spheroconia, ... 214

Figure 1. Sponge; nat. size.

,, 2. Vertical median section through one lobe, showing the general character of the excurrent canal system; nat. size.

,, 3–9. Spicules—

Fig. 3. Strongyle; × 125.
„ 4. Orthotriæne; × 125.
„ 5. Sterraster; × 125.
„ 6. Somal spherule; × 430.
Fig. 7. Exceptionally large somal spherule; × 430.
„ 8, 9. Composite spherules, consisting of two or more united together; × 430.

,, 10. Part of the section seen at the left hand upper corner of the cloaca in fig. 2, more highly magnified; × 4.

,, 11. Tangential but slightly oblique section through the ectochrote, showing at the left hand side the pores, to the right the cavities into which they open; × 14.

,, 12. Tangential section through the sterrastral layer; × 14.

,, 13. Transverse section through the cortex and part of the choanosome; × 14.

,, 14. Transverse section through the ectochrote; × 292.

,, 15. Section through a part of the choanosome, showing the aphodal character of the chamber-system; × 180.

,, 16. Similar, showing the spherules *in situ* (within cells not distinguishable from sarcencytes); × 430.

,, 17. A flagellated chamber seen *en face*, showing the fenestrated membrane; × 430.

,, 18. A young sperm cell; × 292.

,, 19. A sperm-cluster, showing the residual nucleus in the midst; × 292.

,, 20. A sperm-cluster; × 292.

,, 21. Isolated spermatozoa; × 430.

,, 22. Section showing the sarcenchyme, with spherules in some of the sarcencytes; × 430.

T.H.Thomas del. W.J.Sollas dir. F.Huth Lith^r Edin^r

CAMINUS SPHÆROCONIA.

PLATE XXVIII.

PLATE XXVIII.

PAGE

Erylus formosus, ... 209

Figure 1. Sponge; nat. size.

„ 2. Vertical section passing through the middle of the cloaca; nat. size. (The section as represented is turned sideways up.)

„ 3–13. Spicules—

Fig. 3. Oxea; × 95.
„ 4. Orthotriæne; × 95.
„ 5, 6. Sterraster; × 95.
„ 7. Somal centrotylote microstrongyle; × 95.
„ 8. Choanosomal oxyaster; × 95.
„ 9. Choanosomal oxyaster; × 292.
Fig. 10. Sterraster, × 292; 10*a*, transverse section of sterraster.
„ 11. Sterraster, in the stage immediately preceding completion; × 292.
„ 12. A still younger form of sterraster; × 292.
„ 13. Somal centrotylote microxea; × 360.

„ 14. Tangential section through the cortex, showing transverse sections of the chones; × 14.

„ 15. Part of a vertical median section passing through the cloaca; × 14.

„ 16. Section at right angles to the surface of the sponge; × 50.

„ 17. Part of the same, more highly magnified; × 125.

„ 18. Structure of the superficial part of the cloacal wall, just below the margin of the oscule; × 292.

„ 19. Part of a section through the choanosome; × 225.

„ 20. A pigment cell; × 225.

„ 21. Darkly staining cell, from which probably the pigment cell arises; × 292.

„ 22. Pigment cell surrounded by sarcencytes; × 292.

„ 23, 24. Problematical structures; × 292.

„ 25. Epithelial cells seen in the walls of an excurrent canal; × 292.

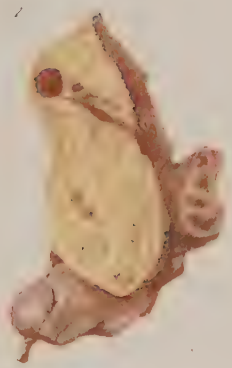
„ 26. Chiaster seen within its scleroblast; × 292.

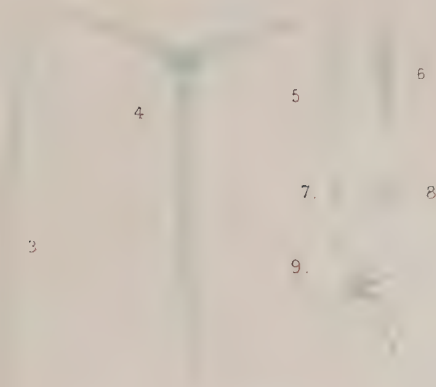
„ 27, 28. Two forms of chiaster; × 292.

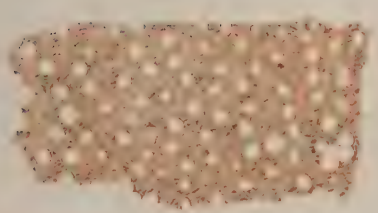
„ 29. Chiaster situated beneath the epithelium of a canal, showing the tangential position of the actines; × 292.

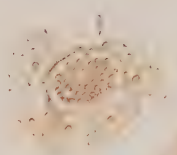
„ 30. The youngest form of sterraster observed; × 292.

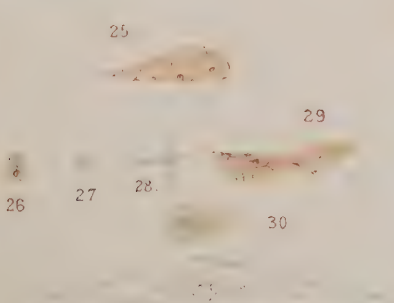
„ 31. A young sterraster, showing the nucleus and immediately surrounding protoplasm of the scleroblast; × 292.

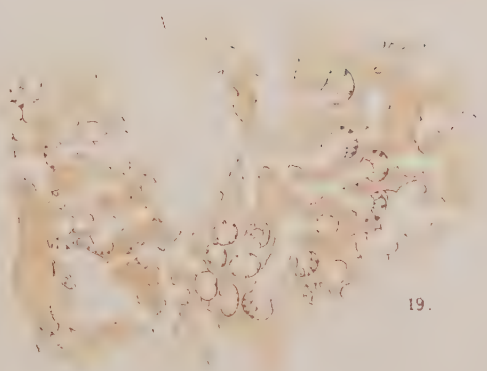












ERYLUS FORMOSUS.

PLATE XXIX.

PLATE XXIX.

PAGE

Theonella swinhoei, ... 284

Figure 1. Sponge; nat. size. Lateral view.

„ 2. Sponge, seen from the oscular end; nat. size.

„ 3. Vertical median section of the sponge; nat. size.

„ 4–8. Spicules—

Figs. 4, 4*a*–4*e*. Various forms of phyllotriaenes; × 73.

„ 5, 5*a*–5*c*. Microstrongyles; fig. 5, a young form; figs. 5*a*–5*c*, various forms of fully grown spicules; × 500.

„ 6, 6*a*–6*e*. The strongyle; fig. 6, the usual form, × 95; figs. 6*a*, 6*b*, ends of strongyles, showing the enlargement of the axial rod, × 360; fig. 6*c*, an example with tylote ends, × 95; fig. 6*d*, the tylote ends, more highly magnified, × 360.

Figs. 7, 7*a*. Tetracrepid desmas; × 73.

„ 8, 8*a*, 8*b*. Young forms of the desma; × 430.

T. H. Thomas, del. W. J. Sollas dir Geo. West & Sons lith. et imp

THEONELLA SWINHOEI, Gray.

PLATE XXX.

PLATE XXX.

PAGE

Theonella swinhoei, ... 284

Figure 1. Part of a vertical median section through a small example of the sponge; on the right the collenchymatous wall of the cloaca, on the left the ectosome, between them the choanosome; × 10.

„ 2. Tangential but slightly oblique section through the ectosome, showing on the lower margin the pore areas, and above them the ramifying subdermal cavities; × 10.

„ 3. Tangential superficial slice, showing two groups of pores; × 95.

„ 4. A single pore: the surrounding epithelium appears as a nucleated membrane, below it are scattered microstrongyles; × 360.

„ 5. Section at right angles to the surface; the darker portion represents the ectosome, the lighter the choanosome; × 20.

„ 6. Section at right angles to the surface through the roof of a chone; × 430.

„ 7. Section through the choanosome, showing the characters of the chamber system, on the right a strand of fusiform cells: the linear series of dots in the choanosome indicate Oscillaria; × 180.

„ 8. Part of the preceding more highly magnified; × 700.

„ 9. A nearly longitudinal section through a canal, showing the collenchymatous walls; × 49.

„ 10. A similar but transverse section; × 49.

„ 11. Part of the preceding section, more highly magnified; × 300.

„ 12. Part of the choanosome, containing parasitic cells; × 430.

„ 13. Longitudinal section through a fibrous strand; on the left epithelial cells, on the right associated Oscillaria are seen; × 360.

„ 14. Similar to fig. 12; × 430.

„ 15. Epithelium, showing cellular outlines, from the walls of a canal; × 540.

„ 16. Similar, but with the cells isolated; × 540.

„ 17. A section through the choanosome, showing strongyles *in situ*, with associated spongin, indicated by the darker tint; × 95.

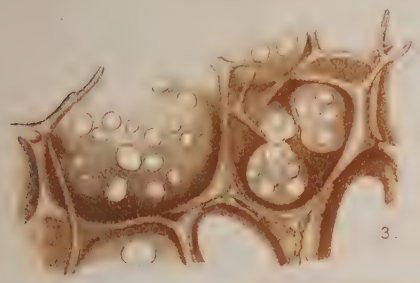
„ 18. A cell occupying the interspace between the syzygial tubercles of two desmas; × 360.

„ 19. A desma, indicated by the untinted part with a blue outline, showing the scleroblast *in situ* over the centre; × 430.

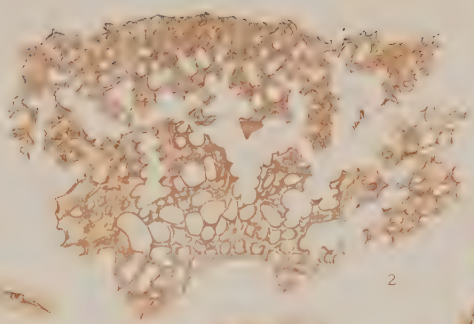
„ 20. The young crepis of a desma seen embedded in its scleroblast; × 292.

„ 21. Similar, but the crepis still smaller, and presumably younger; × 292.

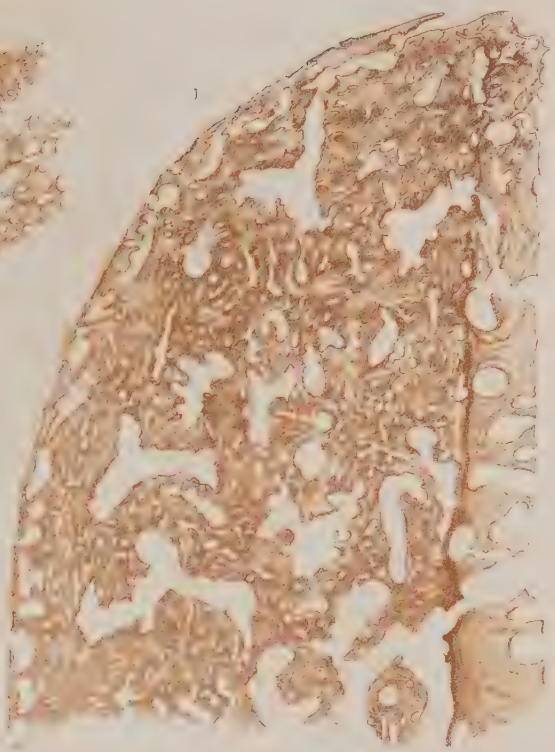
„ 22. Tissue replacing the collenchyma in some parts of the sponge; × 540.



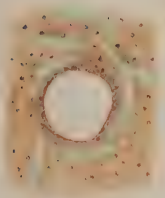
3.



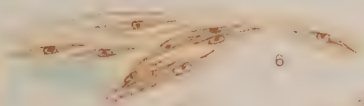
2.



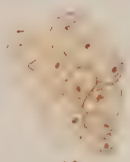
1.



4.



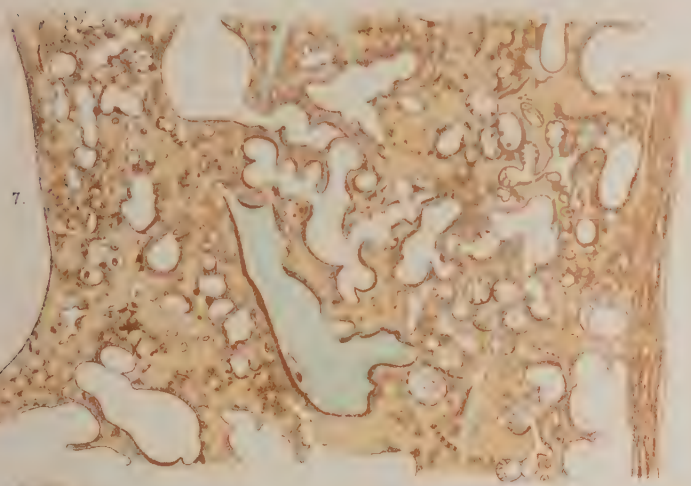
6.



16.

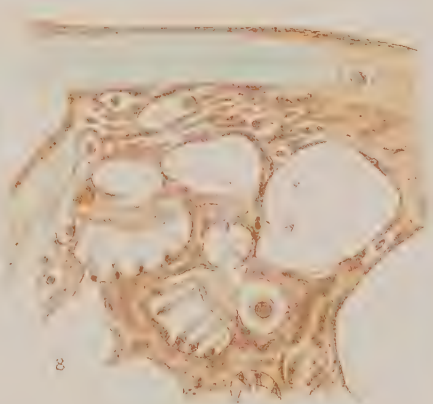
17.

5.



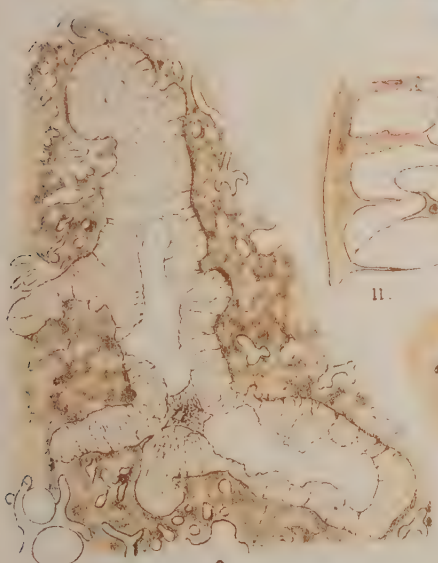
7.

18.

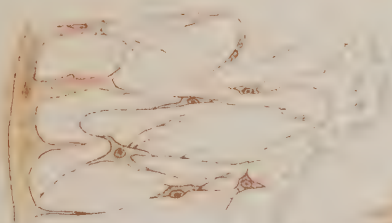


8.

14.

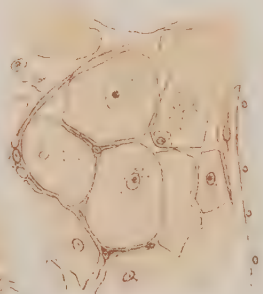


9.



11.

19.



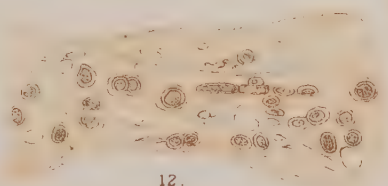
22.

13.

20.

10.

21.



12.

T.H.Thomas del

W.J.Sollas dir.

F.Huth, Lith.r Edin.r

THEONELLA SWINHOEI.

PLATE XXXI.

PLATE XXXI.

PAGE

Figs. 1–6. *Discodermia ornata*, . . 297

Figure 1. Skeleton of the sponge; nat. size.

„ 2–6. Spicules—

Figs. 2, 2*a*. Oxeas; × 95.
„ 3, 3*a*, 3*b*. Microxeas; 3*a*, centroclinate; 3*b*, centrotylote; × 360.
„ 4. Microstrongyles; × 360.
„ 5, 5*a*–5*d*. Discotriænes; × 95.

Figs. 6, 6*a*–6*c*. Tetracrepid desmas; fig. 6*b* shows on the right the character of the zygosis; fig. 6*c* shows a tetraradiate cavity produced by an enlargement of the canal of the crepis; × 73.

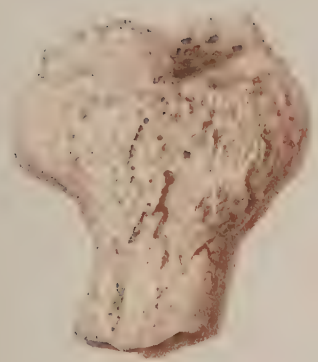
Figs. 7–12. *Neosiphonia superstes*, . . . 299

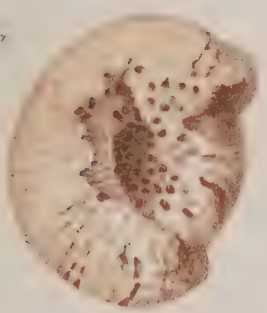
„ 7, 7*a*, 7*b*. The sponge; figs. 7 and 7*b* seen from opposite sides, 7*a*, from above; nat. size.

„ 8–12. Spicules—

Fig. 8. Oxea; × 38.
„ 9, 9*a*. Spirasters; × 360.
„ 10. Dichotriæne; × 95.
„ 10*a*. Trichotriæne; × 95.

Figs. 11, 11*a*. The desma; fig. 11 seen by reflected light; × 73.
„ 12, 12*a*. Examples of the mode of zygosis; × 150.





Figs 1-6, DISCODERMIA ORNATA. Figs 7-12, NEOSIPHONIA SUPERSTES.

PLATE XXXII.

PLATE XXXII.

PAGE

Figs. 1–11. *Discodermia discifurca*, . . . 292

Figure 1. Sponge; nat. size.

„ 2. Section at right angles to the surface, showing the skeleton of the sponge with the phyllotriænes in place, clothed by an incrusting Monaxonid; × 63.

„ 3. Section through part of the choanosome; × 292.

„ 4–11. Spicules—

Figs. 4, 5. Tetracrepid desma; × 86.
„ 6. An abnormal form of desma, with only three epactines; × 86.
Figs. 7–9. Different forms of phyllotriæne; × 86.
„ 10. Microxea; × 292.
„ 11. Microstrongyle; × 292.

Figs. 12–25. *Discodermia panoplia*, . . . 295

„ 12. The sponge; nat. size.

„ 13–20. Spicules—

Fig. 13. Tetracrepid desma; × 63.
„ 14. A part of the desma more highly magnified, to show the character of the syzygial tubercles; × 125.
„ 15–19. Discotriænes; figs. 15–17, × 49; figs. 18, 19, × 63.
Fig. 20. Discotriænes of the superficial and immediately underlying layer from near the base of the sponge, showing the zygosis of the desmas of the latter layer; × 125.

„ 21. Poral surface of the sponge, showing the poral sinuses of the discotriænes; × 37.

„ 22. A part of the oscular surface with the superficial discotriænes removed, to show the nature of the rhabdal sinuses; × 49.

„ 23. Oscular surface; × 37.

„ 24. A fragment of skeleton from a cavity in the limestone on which the sponge is attached, to show the modifications undergone by the syzygial tubercles, which have become flattened and laminar; × 63.

„ 25. A young discotriæne; × 63.

T H Thomas del. W.J.Sollas dir. F.Huth, Lith^r Edin^r

Fig^s 1-11, DISCODERMIA DISCIFURCA. Fig^s 12-25, DISCODERMIA PANOPLIA.

PLATE XXXIII.

PLATE XXXIII.

PAGE

Pleroma turbinatum, ... 312

Figure 1. Sponge; nat. size.

„ 2. The same, showing the cut face from which the thin slices were prepared; nat. size.

„ 3–8. Spicules—

Fig. 3. Dichotriæne; × 73.
„ 4. Oxea; × 73.
„ 5. Microxea; × 73. The two figures to the right the same; × 292.
„ 6. Spiraster; × 73. The four figures vertically below this are examples of the same more highly magnified, the first three × 292, the last × 360.
„ 7, 7*a*–7*e*. Rhabocrepid desmas, × 73; 7*b*′, the crepis, × 292.
„ 8. The young desma at a very early stage; × 73.

Fig. 8*a*. The same at a stage slightly more advanced, showing the crepis in the middle of the epirabd; × 73.
„ 8*b*, 8*c*, 8*d*. All young forms of desma; × 73. 8*d*′. The crepis as seen in 8*d* more highly magnified; × 292.
„ 8*e*. The epactine of a desma showing the crepis and the enveloping granular and clear layers; × 292.
„ 8*f*. Two desmas, showing the mode of zygosis; × 73.

„ 9. Section at right angles to the surface, showing the general characters of the cortex and choanosome; × 12.

„ 10. A part of the choanosome of the preceding, more highly magnified, to show the characters of the chamber-system; × 292.

„ 11. Flagellated chambers, showing the fenestrated membrane; × 430.

„ 12. Two choanocytes; × 540.

„ 13. Part of the cortex to show its histological characters; × 360.

„ 14. A problematical cell from the choanosome; × 430.

„ 15, 15*a*. Sections at right angles to the surface of desmas, showing associated protoplasmic structures; × 540.

„ 15*b*, *c*, *d*. Protoplasmic structures coating the surface of the desmas seen *en face*; × 540.

J. H. Thomas del. W. J. Sollas dir F. Huth, Lith^r Edin^r

PLEROMA TURBINATUM.

PLATE XXXIV.

PLATE XXXIV.

PAGE

Figs. 1–13. *Corallistes masoni*, ... 303

Figure 1. Sponge; nat. size.

„ 2–8. Spicules—

Fig. 2. Dichotriæne; × 63.
„ 2*a*. Cladome, seen *en face*; × 63.
„ 3. A very young form of desma; × 73.
„ 4. Another young form, more enlarged, showing the crepis; × 180.
Fig. 5. A stage further advanced; × 180.
„ 6. A stage still later; × 73.
„ 7, 8. Fully grown desmas; × 73.

„ 9. Section through part of the choanosome, showing a strand of fusiform cells, the function of which is unknown; × 225.

„ 10. A part of the choanosome, showing flagellated chambers; × 225.

„ 11. Epithelial surface seen on the walls of one of the canals; × 430.

„ 12. Section through part of the cortex, showing vacuolar connective tissue; × 360.

„ 13. Section at right angles to the surface of the sponge, showing the general appearance of the cortex: the clear oval spaces of uniform size are the vacuoles of the vacuolar connective tissue; × 95.

Figs. 14–19. *Corallistes typus*, ... 301

„ 14. The sponge; nat. size.

„ 15. The face of a section taken through a median vertical plane; nat. size.

„ 16. Section at right angles to the surface, showing the arrangement of the hard parts in the ectosome; × 125.

„ 17. One of the problematical hollow siliceous bodies (Diatoms?) strewn through the ectosome; × 292.

„ 18. Dichotriæne; × 63; fig. 18*a*, cladome of the preceding seen *en face*; × 63.

„ 19. Centrotylote microxea, which was observed as an adventitious form apparently resulting from the modification of a spiraster; × 292.

Figs. 20–22. *Pachymatisma johnstonia*, ... 242

„ 20. Part of figure 21, more highly magnified; × 292.

„ 21. Transverse section through one of the oscular canals of the cortex; × 51.

„ 22. The epithelium of an intercortical canal, seen *en face*; × 360.

T. H. Thomas del. W. J. Sollas dir. F. Huth, Lith. Edin.

Figs. 1-13 CORALLISTES MASONI. Figs. 14-19, CORALLISTES TYPUS. Figs. 20-22, PACHYMATISMA JOHNSTONI.

PLATE XXXV.

PLATE XXXV.

PAGE

Figs. 1–11. *Azorica crassiuscula*, ... 324

Figure 1. The sponge, seen from the poral surface; nat. size.

„ 2. A part of the sponge, seen from the oscular face; nat. size.

„ 3–11. Spicules—

Fig. 3. Oxea; × 125.
„ 4. Part of a desma; × 180.
„ 5–10. A series of desmas in different stages of growth, the youngest to the left; × 180.
Fig. 11. A not quite adult desma, showing the crepis; × 180.

Figs. 12, 13. *Corallistes thomasi*, ... 307

„ 12. The sponge seen from the poriferous face; nat. size.

„ 13. The same seen from the oscular face; nat. size.

(For the spicules of this sponge, see Pl. XV. figs. 40–46.)

Figs. 14–22. *Azorica marginata*, ... 323

„ 14–22. Spicules—

Figs. 14, 15. Desmas; × 63.
„ 16. Part of a desma, showing syzygial processes.
„ 17. Form frequently assumed by the desma near the surface of the sponge, the upper side of the drawing is that turned towards the surface in the sponge; × 63.
Fig. 18. Part of a desma, showing the syzygial ends; × 225.
„ 19. A young desma, consisting almost solely of the crepis, of which the axial rod is shown; × 225.
„ 20. Desma more advanced; × 225.
„ 21. Desma after treatment with caustic soda; × 63.
„ 22. Oxea; × 180.

Fig. 23. *Triptolemus cladosus*, ... 93

„ 23. Centrotriæne; × 225.

Figs. 24, 25. Isolated undetermined spicules, found associated with *Corallistes thomasi*.

„ 24. This spicule, of which numerous examples were observed, presents a straight rhabdome measuring about 0·45 by 0·04 mm., traversed by an axial rod 0·24 mm. long, with numerous short, usually bifid cladi, given off all along its length; these do not appear to be adapted for zygosis, and it is doubtful whether the spicule is to be assigned to the Monaxonida or the Lithistida; it may be named provisionally *Orthorachis problematica*; × 95.

„ 25. A microsclere probably of *Corallistes thomasi*; × 300.

Figs. 26–50. *Scleritoderma flabelliformis*, ... 316

„ 26–28. The sponge; nat. size. The first two figures represent the oscular, the third the poriferous face.

„ 29–50. Spicules—

Figs. 29–33. Various forms of the microstrongyle; × 360.
„ 34–41. The desma in various stages of growth, commencing with the youngest, × 95; fig. 35*a* is a more magnified representation of fig. 35; × 360.
„ 42. The epirabd of a desma, showing the crepis; × 200.
Figs. 43–49. Various forms of desma; × 95. Fig. 45 represents a form frequently assumed by desmas lying near the surface of the sponge.
„ 50. Syzygial processes; highly magnified.

J H Thomas del. W J Sollas dir F Huth, Lith^r Edin^r

Figs 1-11, AZORICA CRASSIUSCULA. Figs 12-13, CORALLISTES THOMASI. Figs 14-22, AZORICA MARGINATA.
Fig. 23, TRIPTOLEMUS CLADOSUS. Figs 24-25, Isolated undetermined SPICULES.
Figs 26-50, SCLERITODERMA FLABELLIFORMIS.

PLATE XXXVI.

PLATE XXXVI.

PAGE

Azorica pfeifferæ, ... 319

Figure 1. The sponge; nat. size.

„ 2–20. Spicules—

Figs. 2, 3. Oxeas; × 95.
„ 4–13. Various stages in the growth of the desma; × 95 (except fig. 9, which is × 200).
Figs. 14–19. Various forms of the fully grown desma; × 95.
„ 20. Two desmas in zygosis; × 200.

„ 21. Part of section through the choanosome, showing the general appearance of the tissue; × 180.

„ 22. Section at right angles to the surface, showing fusiform cells directed at right angles to the external epithelium; × 300.

„ 23. Part of a section through the choanosome; × 360.

„ 24. Isolated mesodermal cells; × 430.

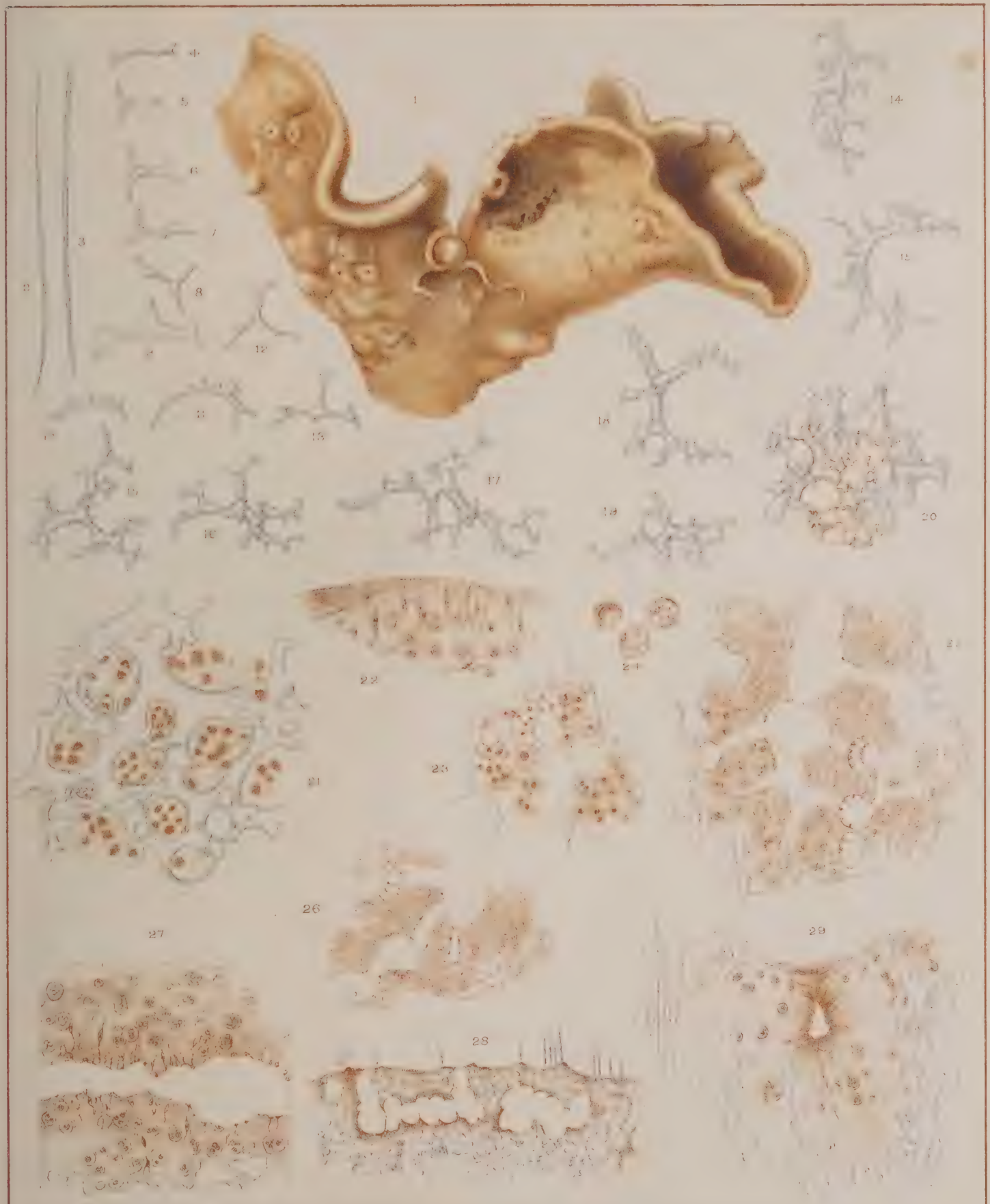
„ 25. Section through the choanosome, showing the general characters of the chamber-system; × 360.

„ 26. Similar to the preceding, but more highly magnified; × 430.

„ 27. Longitudinal section through one of the water canals; × 240.

„ 28. Section at right angles to the surface, showing the arrangement of the subdermal cavities; × 34.

„ 29. Part of a similar section taken from the oscular side of the sponge; × 180.



W.J.Sollas dir Geo.West & Sons lith.et imp

AZORICA PFEIFFERÆ, (Carter)

PLATE XXXVII.

PLATE XXXVII.

PAGE

Siphonidium capitatum, ... 317

Figure 1. The sponge; nat. size.

„ 2–21. Spicules—

Fig. 2. Ectosomal desma; × 292.

„ 3–8. Various forms of choanosomal desma; × 95. Fig. 3 represents a form frequently assumed when the desma occurs immediately below the external surface.

„ 9–15. A series of young desmas, arranged in the order of age; fig. 9 represents an example scarcely advanced beyond the stage of crepis, in fig. 14 the crepis is to be seen in the middle of the spicule. Fig. 9 × 200, figs. 10–12 × 360, figs. 13, 14 × 200, fig. 15 × 95.

Figs. 16, 17. Three examples of the oxytylote, showing the much enlarged axial canal; × 200.

„ 18–20. The tylote terminations of other examples; × 200.

„ 21. Desmas in zygosis; on the right lower corner of the figure a small secondary desma is to be seen; × 95.

„ 22. The skeleton of the terminal part of one half of one of the tubular processes of the sponge, cut longitudinally; × 95.

„ 23. Transverse section through the wall of one of the tubes; × 73. The thin line tinted brown and blue situated to the right, separated from the rest of the section, represents the displaced outer membrane which bounds the exterior of the sponge.

„ 24. Part of a transverse section, to show the collenchymatous layer in the interior of the tube; × 49.

„ 25. Section through the choanosome, showing flagellated chambers; × 292.

„ 26. Vacuolar structure seen in the collenchyma of fig. 24; × 292.

„ 27. Vacuolated tissue lying below the external membrane of the sponge; × 360.

W.J.Sollas dir.

Geo.West & Sons lith.et imp

SIPHONIDIUM CAPITATUM.

PLATE XXXVIII.

PLATE XXXVIII.

PAGE

Figs. 1–12. *Psammastra murrayi*, ... 175

Figure 1. Sponge; nat. size.

„ 2. Vertical section; nat. size.

„ 3–12. Spicules—

Fig. 3. Plagiotriæne; × 73.
„ 4-9. Various forms assumed by the cladome of the plagiotriæne; × 180 (except fig. 4, × 292).
Fig. 10. Microstrongyles; × 430.
„ 11. Oxyaster; × 430.
„ 12. Spheraster; × 430.

Figs. 13–17. *Tetilla coronida*, ... 9

„ 13, 14. The sponge, nat. size; fig. 13, seen from above; fig. 14, lateral view.

„ 15–17. Spicules—

Fig. 15. Protriæne; 180.
„ 16. Cladal end of anatriæne; × 180.
Fig. 17. Cladal end of anamonæne; × 180.

Figs. 18–27. *Pilochrota pachydermata*, ... 122

„ 18, 19. The sponge; nat. size.

„ 20–23. Spicules—

Fig. 20. Oxea; × 73.
„ 21. Orthotriæne; × 73.
Fig. 22. Anatriæne; × 73.
„ 23. Chiaster.

„ 24. Superficial tangential section from the surface of the sponge, showing in the middle a sieve-pore. The epithelial outlines are not seen in the preparation, and are only introduced to indicate the position of the epithelium; × 200.

„ 25. Section at right angles to the surface, showing the characters of the cortex and of the incurrent chones; × 51.

„ 26. One side of a median longitudinal section through an oscular chone; × 73.

„ 27. A more magnified representation of the outer layer of the lower part of the preceding, to show the supposed æsthocytes beneath the epithelium; × 292.

Figs. 28–30. *Callipelta ornata*,[1] 309

„ 28, 29. Two of the discotriænes; × 292.

„ 30. Amphiaster; × 430.

[1] In the legend at the foot of the Plate this is *Corallistes callipelta*, the name having been changed since the Plate was printed off.

T.H.Thomas del. W.J.Sollas dir. F.Huth, Lith.r Edin.r

Figs 1-12, PSAMMASTRA MURRAYI. Figs 13-17, TETILLA CORONIDA. Figs 18-27, PILOCHROTA PACHYDERMATA.
Figs 28-30, CORALLISTES CALLIPELTA.

PLATE XXXIX.

PLATE XXXIX.

PAGE

Cinachyra barbata, ... 23

Figure 1. A cloaca or vestibule as seen when cut open by a median longitudinal section; × 3.

„ 2. A median vertical section, through the oscular tube, and part of the cloacal wall; × 32.

„ 3. A part of the wall of the cloaca, seen *en face;* × 73.

„ 4. The area around one of the pores of the preceding, more highly magnified; × 292.

„ 5. A tangential section through one of the pillars where the cloacal wall passes into the oscular tube; these pillars are seen in the upper part of fig. 3, between the pore-bearing areas and the fibrous layer; × 292.

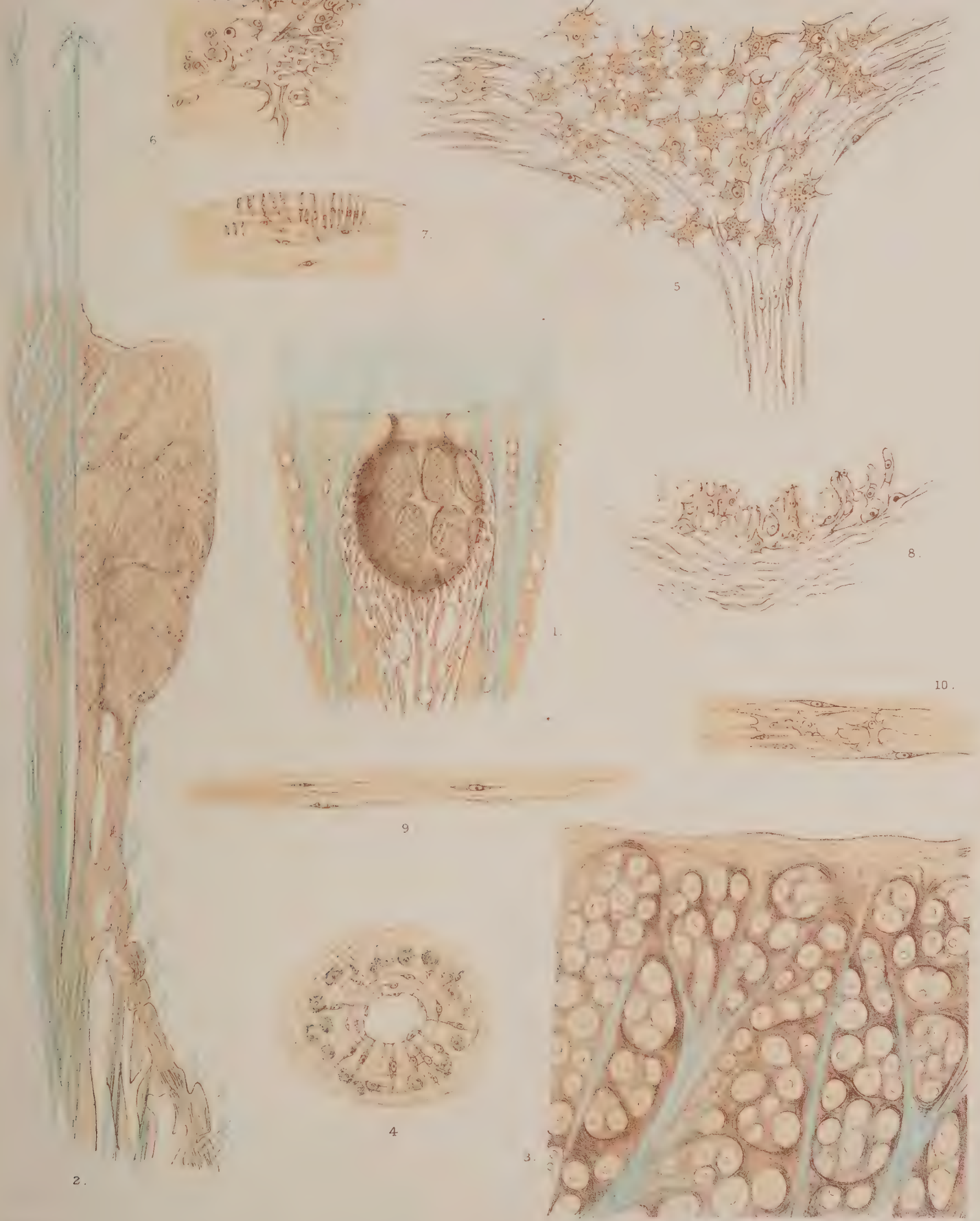
„ 6. Transverse section through the margin of an oscule of a very young sponge, showing a supposed æsthocyte, which is continued at its inner extremity into a collencyte, this in turn is continuous with the sheath of a myocyte; the oblique cylindrical brown bodies looking like rods seen on the right of the figure, slanting to the right within clear spaces, are myocytes cut across obliquely; the horizontal line bounding the figure above is an epithelial surface; × 576.

„ 7. A similar section to the foregoing, also from a very young sponge, showing several fusiform cells lying immediately beneath the epithelium and at right angles to it; × 292.

„ 8. Transverse section through part of the oscular tube of a fully-grown sponge; the epithelial surface is uppermost in the figure, it takes a very irregular course, and below it are numerous supposed æsthocytes, deeper inwards these are followed by concentrically arranged myocytes; × 292.

„ 9. Myocytes, as seen in a teased preparation; × 292.

„ 10. Myocytes in continuity with collencytes, as seen in a teased preparation; × 292.



T.H. Thomas del

W.J. Sollas dir.

F. Huth Lith.r Edin.r

CINOCHYRA BARBATA.

PLATE XL.

PLATE XL.

PAGE

Figs. 1, 2. *Anthastra parvispicula*, . . . 145

Figure 1. A poral chone in transverse section, to show the position of two supposed æsthocytes; × 73. The æsthocytes are indicated by two dashes on the right of the figure, slanting downwards towards a recess in the chone.

„ 2. Part of the preceding, more highly magnified, to show the supposed æsthocytes, which present a somewhat darker tint than the other cellular constituents of the tissue; × 292.

Figs. 3, 4. *Cydonium glariosus*, . . . 223

„ 3. Transverse section through the cortex and adjacent choanosome, showing embedded sand grains and pencils of small oxeas; × 32.

„ 4. Tangential slice from the surface of the sponge, showing the pores, and the asters below the epithelium; × 180.

Fig. 5. *Craniella simillima*, . . . 30

„ 5. Longitudinal median section through the solid planula; × 73. The columnar cells of the outer layer are shown more highly magnified above the chief figure; × 430.

Fig. 6. *Characella aspera*, . . . 92

„ 6. The sponge; nat. size.

Fig. 7. *Placospongia carinata*, . . . 272

„ 7. Transverse section; × 10.

Fig. 8. *Astrella vosmaeri*, ... 136

„ 8. Transverse section through the cortex, showing the characters of the chones; × 51.

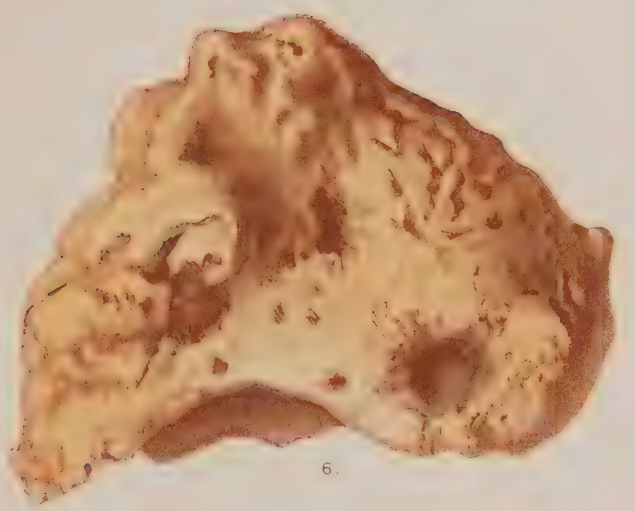
1.

2.

3.

5.

4.



6.

7.

8.

T.H. Thomas del. W.J. Sollas dir. F. Huth, Lith.r Edin.r

Figs 1-2, ANTHASTRA PARVISPICULA. Figs 3-4, CYDONIUM GLARIOSUS. Fig. 5, CRANIELLA SIMILLIMA.
Fig. 6, CHARACELLA ASPERA. Fig. 7, PLACOSPONGIA CARINATA. Fig. 8, ASTRELLA VOSMAERI.

PLATE XLI.

PLATE XLI.

PAGE

Figs. 1–4. *Disyringa dissimilis*, ... 161

Figure 1. The sponge; nat. size. On the right of the upper end of fig. 1*d* a section is shown of the cloacal tube; in a corresponding position at the lower end a transverse section of the poriferous incurrent tube; fig. 1*b* represents the termination of the cloacal tube; the sponge of fig. 1*c* possesses the longest incurrent tube observed, and this is not complete.

„ 2. The sponge, restored from the fragments shown in the preceding figure; nat. size.

„ 3. A diagrammatic median longitudinal section through the sponge; nat. size. *a*, A transverse section through the cloacal tube; *b*, a transverse section through the incurrent tube; *c*, a transverse section through the sponge in the region just where the incurrent tube divides after entering the sponge.

„ 4. Transverse section through the body of the sponge, showing the symmetrical arrangement of the excurrent and incurrent canals which alternate with each other. *I*, incurrent, *E*, excurrent canals; × 4.

„ 5. A facial view of the wall of the excurrent tube of *Tribrachium schmidtii*, seen from without; × 73. (The figure would answer as well for the excurrent tube of *Disyringa dissimilis*.)

Figs. 6–21. *Tetilla pedifera*, ... 6

„ 6. The sponge; nat. size.

„ 7. Section at right angles to the surface, showing the folding of the spongophare; sperm-clusters will be observed in places; × 73.

„ 8–12. Spicules—

Fig. 8. Anisocladal protriæne; × 180. The rhabdome of this should have been represented as broken at the centripetal end.

„ 9. Promonæne; × 180.

Fig. 10. Cladal end of anisocladal prodiæne; × 180.

„ 11. Cladal end of anisocladal protriæne; × 180.

„ 12. Cladal end of an anamonæne; × 180.

„ 13. Spermatoblast; × 292.

„ 14. The earliest stage of segmentation observed; × 292.

„ 15. A developing sperm-cluster; × 292. Fig. 15*a*, a few of the segmentation cells of the preceding, more highly magnified; × 576.

„ 16. Sperm-cluster, almost mature; × 292. Fig. 16*a*, some of the developing spermatozoa, more highly magnified; × 576.

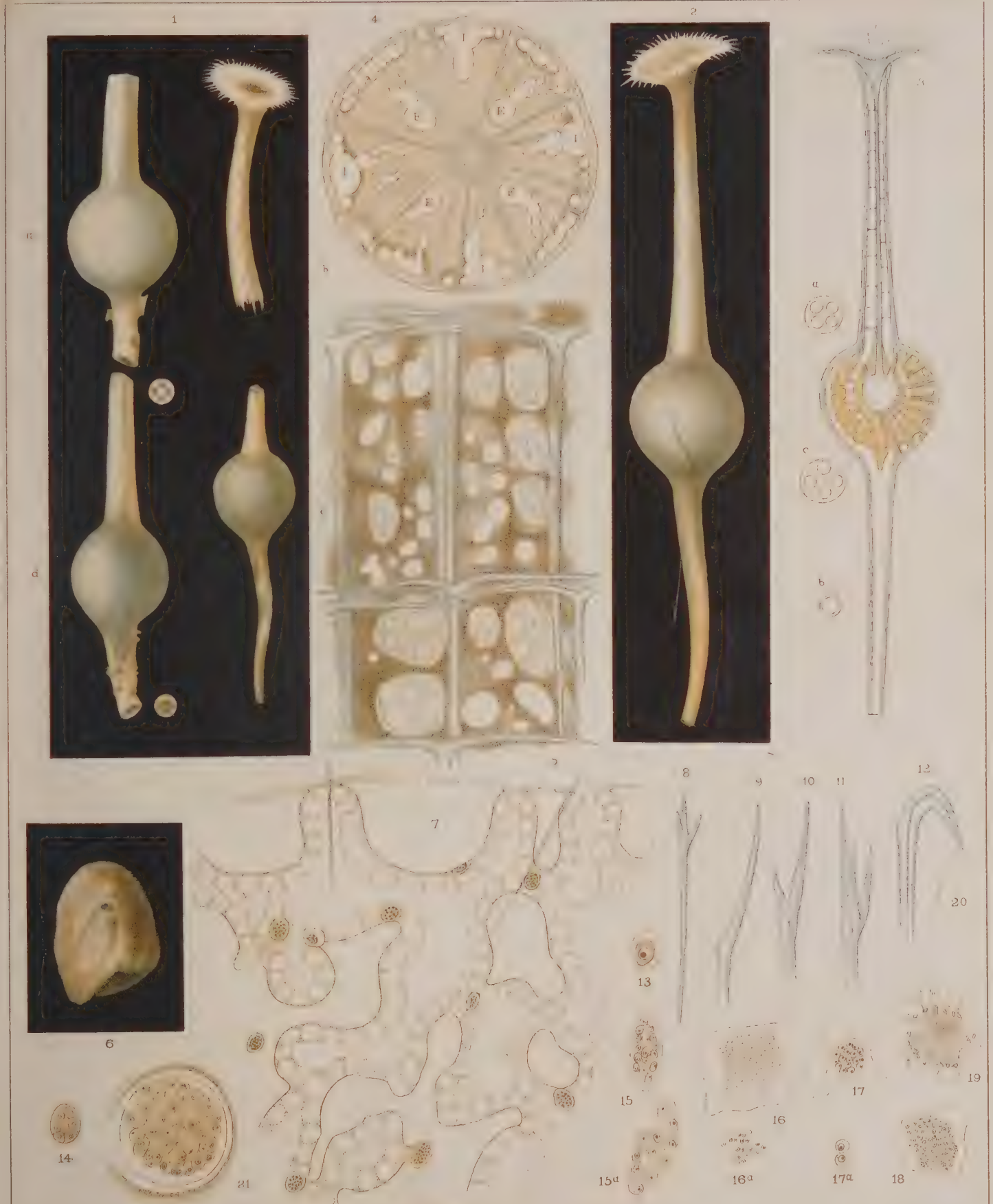
„ 17. A sperm-cluster in a stage somewhat later than that of fig. 15; × 292. Fig. 17*a*, some of the segmentation cells, more highly magnified; × 576.

„ 18. Sperm-cluster in a stage more advanced than the preceding; × 292.

„ 19. An abnormal appearance presented by a sperm-cluster; × 292.

„ 20. A mature spermatozoon; × 576.

„ 21. A problematical body, apparently the segmentation of an ovum; × 292.



T. H. Thomas, del

W. J. Sollas dir.

Geo. West & Sons lith. et imp

1—4 DISYRINGA DISSIMILIS.
5 TRIBRACHIUM SCHMIDTII.
6—21 TETILLA PEDIFERA.

PLATE XLII.

PLATE XLII.

PAGE

Figs. 1, 2. *Sphinctrella gracilis*, . . . 89

Figure 1. Microxea, spirally ridged; × 292.

„ 2. Spiraster; × 720.

Figs. 3, 4. *Sphinctrella ornata*, . . . 90

„ 3. Triod, with spirally arranged ridges on the actines; × 292.

„ 4. Spiraster; × 720.

Figs. 5–11. *Amphius huxleyi*, . . . 178

„ 5. The sponge; nat. size.

„ 6. Oxea; × 200.

„ 7. Amphiasters; × 720.

„ 8. Longitudinal median section through a lobe of the sponge, showing the cloaca; nat. size.

„ 9. Section at right angles to the surface, to show the general arrangement of the canals and spicules; × 7.

„ 10. Tangential slice from the surface, showing the pores and oxeas disposed tangentially beneath the epithelium; × 180.

„ 11. Section at right angles to the surface, passing through a pore-sieve, and the underlying incurrent canal; × 73.

Figs. 12–19. *Dorypleres dendyi*, . . . 426

„ 12. The sponge; nat. size.

„ 13–19. Spicules—

Fig. 13. Somal oxea; × 51.
„ 14–16. Somal spherasters; × 180.
„ 17. Ectosomal spheraster; × 180.
Fig. 18. Tylotoxea; × 51. (Possibly not proper to the sponge.)
„ 19. Tylote end of the preceding, more highly magnified.

Figs. 20–21. *Craniella schmidtii*, . . . 39

„ 20. Section through an entire sponge, showing the young sponges and embryos within the parent; × 22.

„ 21. A part of the preceding, more highly magnified, showing a planula penetrating the cortex; × 51.

T. H Thomas del.

W. J. Sollas dir.

F Huth, Lith^r Edin^r

Fig. 1-2, SPHINCTRELLA GRACILIS. Fig. 3-4, SPHINCTRELLA ORNATA. Fig. 5-11, AMPHIUS HUXLEYI.
Fig. 12-19, DORIPLERES DENDYI. Fig. 20-21, CRANIELLA SCHMIDTII.

PLATE XLIII.

PLATE XLIII.

PAGE

Figs. 1–9. *Scolopes moseleyi*, . . . 432

Figure 1. The sponge; nat. size.

,, 2–7. Spicules—

Fig. 2. Oxea of the spicular fibres; × 51.
,, 3. Oxea of the cortex; × 51.
,, 4. Microxea of the cortex and choanosome; × 51.

Figs. 5–7. Amphiasters; × 720. (In fig. 6, three whorls of actines are present, it thus calls to mind the sceptrella).

,, 8. Transverse section through the cortex, to show the arrangement of the spicules; × 51.

,, 9. A part of the preceding, more highly magnified, to show the arrangement of the microxeas; × 200.

Figs. 10–12. *Isops apiarium*, . . . 268

,, 10. Diactinate reductions of the oxyaster; × 225.

,, 11. Microstrongyle; × 225.

,, 12. Oxyaster; × 225.

Figs. 13–19. *Miscellaneous.*

,, 13. Part of a radial section through a very young example of *Dragmastra normani*, showing the dichotriænes beneath the outer epithelium, with very short rhabdomes; × 200.

,, 14, 14*a*. Two triods from *Placina monolopha*, showing a sigmate form at the origin; fig. 14 × 540; fig. 14*a* × 1080.

,, 15. Transverse section through the cortex of *Tethya lyncurium*, showing segmented ova, or developing internal buds, situated immediately beneath the outer epithelium; × 6½.

,, 16. A part of the preceding more highly magnified, to show the structure of the segmented ova or internal buds; × 292.

,, 17. Part of a radial section through a specimen of *Tethya lyncurium* from Norway. The oscule communicates with the excurrent canal by a sieve-pore; × 10.

,, 18. The terminal portion of an oxea of *Dorypleres dendyi* (wrongly assigned to *Tethya lyncurium* in the legend to the Plate) after treatment with hydrofluoric acid; the outer brown dotted line is an organic sheath which resists solution, the inner brown rod is the axial rod of the spicule; × 292.

,, 19. A dichotriæne of *Dragmastra normani*, with an adventitious cladus. Two of the normal dichocladi (*b* and *c*), are not completely represented in order to save space; *a* is the accessory cladus, its axial rod is separate and distinct from that of the rest of the spicule; × 200.

T.H. Thomas del. W.J. Sollas dir. F. Huth, Lith^r Edin^r

Figs 1-9, SCOLOPES MOSELEYI. Figs 10-12, CAMINUS APIARIUM. Fig. 13, DRAGMASTRA NORMANI.
Figs 14, 14a, PLACINA MONOLOPHA. Figs 15-18, TETHYA LYNCURIUM. Fig. 19, DRAGMASTRA NORMANI.

PLATE XLIV.

PLATE XLIV.

PAGE

Figs. 1–6. *Tethya seychellensis*, ... 427

Figure 1. The sponge; nat. size.

,, 2. Portion of the external surface, somewhat enlarged, to show the character of the conules.

,, 3. Also a part of the exterior surface, but taken from near the oscule, to show the modification which the conules undergo in this region.

,, 4. Transverse section through the sponge; the dark dots in the choanosome, are the ova, which occur scattered throughout it; × $6\frac{1}{2}$.

,, 5. Section through part of the choanosome, showing the distribution of the ova; × 32.

,, 6. Section through part of the choanosome, showing the appearance presented by the flagellated chambers, and the minute characters of the ova; × 292.

Figs. 7–14. *Tethya japonica*, ... 430

,, 7, 8. Two specimens of the sponge; nat. size.

,, 9. Part of the external surface, slightly magnified, to show the characters of the conules and the ridges by which the conules are united together; × $6\frac{1}{2}$.

,, 10. Part of the external surface of the sponge represented by fig. 8; somewhat enlarged.

,, 11. Transverse section, showing the conules of fig. 7 in longitudinal section; × $6\frac{1}{2}$.

,, 12. A median longitudinal section through one of the swellings at the end of the conules in fig. 7, supposed to be an external bud; × 24.

,, 13. A similar "bud" from *Tethya seychellensis*, showing the arrangement of the chief spicules; × 24.

,, 14. A part of the section of fig. 12, more highly magnified, to show the composition of its tissues, which agree with those of the cortex; × 292.

Figs. 15, 16. *Tethya ingalli*, ... 431

,, 15. The sponge; nat. size.

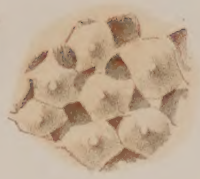
,, 16. Transverse section through the cortex, and adjacent choanosome; × $6\frac{1}{2}$.

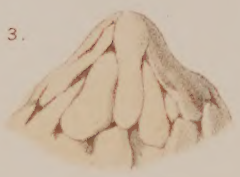
Figs. 17–19. *Tethya lyncurium*, ... 435

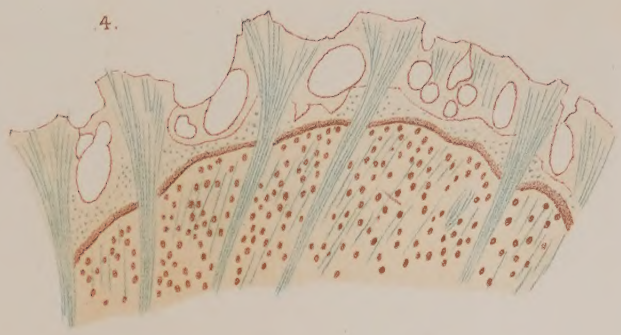
,, 17. An oxea split at the one end under the action of a cold solution of caustic potash; × 292.

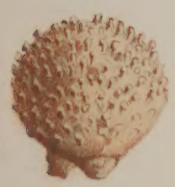
,, 18. An oxea showing the axial rod passing into the protoplasm of the scleroblast; × 360.

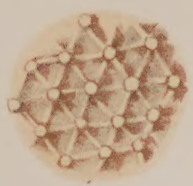
,, 19. Two spherasters, as seen in the cortex, each embedded in a scleroblast; × 292.

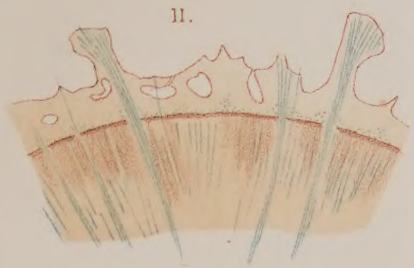


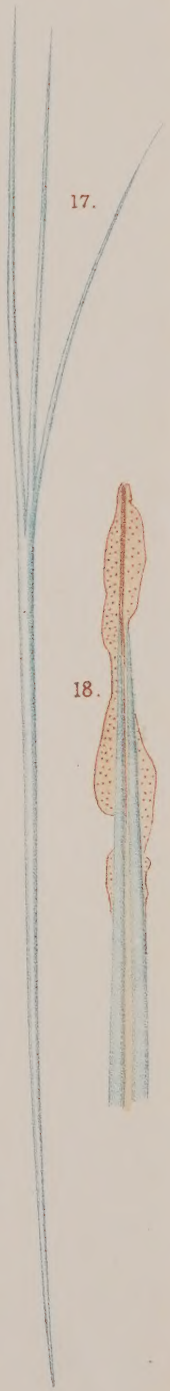


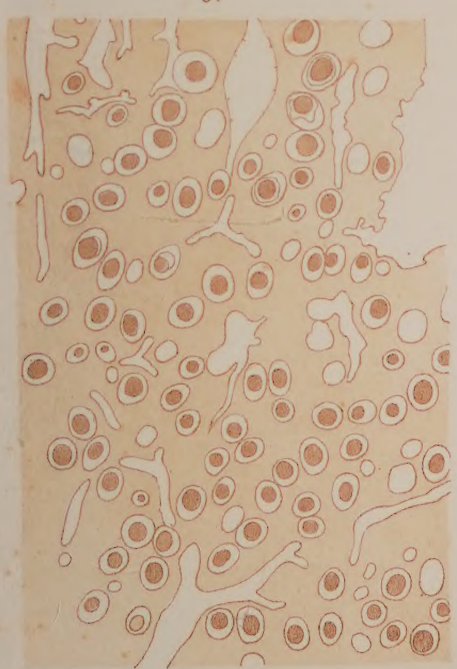


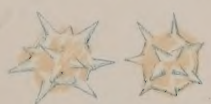












T.H.Thomas del.

W.J. Sellas dir.

F.Huth, Lith^r Edin^r

Figs 1-6, TETHYA SCYCHILLENSIS. Figs 7-14, TETHYA JAPONICA. Figs 15-16, TETHYA INGALLI.

Figs 17-19, TETHYA LYNCURIUM.

AUG 1956
LIBRARY
POFI
FISH & WILDLIFE
SERVICE